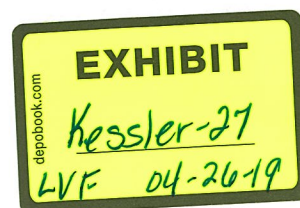


PD13 Exhibit 1

SUPER POPPY

1	J&J Enabled Growth Oxycodone
2	Morphine Chemical Tree
3	J&J #1 Supplier
4	Vertical Integration
5	Super Poppy
6	MNK Aggressive Marketing Generics
7	Super Poppy Case History
8	J&J Noramco Operations



Super Poppy

Tasmanian Super Poppy

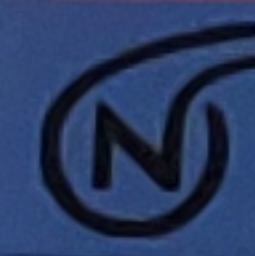
Tasmanian Alkaloids Leads the World in Poppy Technology

Patented, high thebaine poppy was a transformational technology that enabled the growth of oxycodone. Dr Fist was awarded a Johnson Medal.

Poppies with alkaloids in commercially quantities for the first time:
oripavine - basis of a radically new synthesis of naltrexone
reticuline – patented poppy, screened by Janssen

Morphine content of the TasAlk poppy is the highest in the world.

Basic research on the enzymatic pathway

 **NORAMCO INC.** Chemistry • Compliance • Commitment

approximately the same quantity of alkaloid per hectare as conventional varieties, but as thebaine and oripavine instead of morphine.

The development of the **Norman poppy** coincided with the release of a slow release formulation of oxycodone in the USA. The new formulation was very successful, and there was greatly increased demand for the thebaine raw material used for its manufacture.

This new poppy variety was a major turning point in alkaloid production. For the first time, thebaine could be produced efficiently without concomitant production of morphine. High alkaloid *P. somniferum* poppies can be grown without risk of diversion for illicit purposes: thebaine and oripavine are not easily converted into morphine or heroin.

Thebaine can be converted into codeine, which is currently the largest volume API produced from opium alkaloids, so perhaps virtually all the world's opium alkaloids will eventually come from poppies having the **Norman** mutation.

This innovation, like most of the plant breeding projects in the poppy industry, had virtually no input from the public sector. The ideas developed from discussions in Tasmanian Alkaloids and Johnson & Johnson Research, a J&J Company based in Sydney. It drew on the expertise of analytical chemists, geneticists and agriculturists within the companies.

Types of seeds:

Norman – 2/3 Thebaine, 1/3 Oripavine

TED – Thebaine (100%)

Tasman – Codeine / Thebaine (Too new – traces of Thebaine but designed to achieve 100% Codeine)

No Name – Morphine

EVE – Oripavine / Thebaine (60% O, 40% T)

~~IF - the cost to manufacture an alkaloid must be less if you take the "seed by product credit" issue to discuss with TasAlk~~

Field Visit – visit to poppy paddocks : Chris Check

Poppies are grown on a three-year crop rotation cycle.

Sowing is in spring (September), flowering in early summer (December) and harvest in mid-summer (January, February, early March).

Tasmanian Alkaloids does not employ any "growth regulators" and the company feels that this is a distinct advantage over its competitors in terms of alkaloid yield.

A lot depends on weather conditions – rain and wind, etc. Best = wet spring; dry, hot summer. Good soil. Tasmania is coming off a long drought.

J+J Enabled Growth Oxycodone

Tasmanian Alkaloids Leads the World in Poppy Technology

Patented, high thebaine poppy was a transformational technology that enabled the growth of oxycodone. Dr Fife was awarded a Johnson Medal.

Poppies with alkaloids in commercially quantities for the first time:
oripavine - basis of a radically new synthesis of naltrexone
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Morphine content of the TasAlk poppy is the highest in the world.

Basic research on the enzymatic pathway

Organizational Alignment



Noramco Has Three Franchises

AFFILIATE SUPPLY

Sole or dominant source for TOPAMAX, SURGICEL, and a dimer required for ABSORBABLE SUTURES

Sales Value - \$ 1.6 Billion

OPIATE NARCOTIC RAW MATERIALS / APIs

Only global, vertically integrated company

Have played a significant role influencing INCB, DEA policies

SYNTHETIC NARCOTIC APIs

Pain Management APIs

Oxycodone Hydrochloride	- Noramco - Alza
Hydrocodone Bitartrate	- Noramco - Alza
Codeine	- Noramco/TasAlk - Janssen
Morphine Sulfate	
Buprenorphine	
Tilidine	
Vortex (Tapentadol)	- Janssen – Noramco - Alza
Naltrexone	- TasAlk – Cilag - Alza
Fentanyl	- Janssen - Noramco - Alza
Sufentanil	- Janssen - Noramco - Alza
Oxymorphone	

Regulatory Framework

SINGLE CONVENTION ON NARCOTIC DRUGS - 1961



International Narcotics Control Board - UN

Lobby on Control Issues

Assure Balance of Global Supply and Demand



National Regulatory Agencies - DEA

Narcotic Raw Material Imports

API Imports and Exports

Licensing

Quota – Production / Purchase

Tasmanian Akaloids

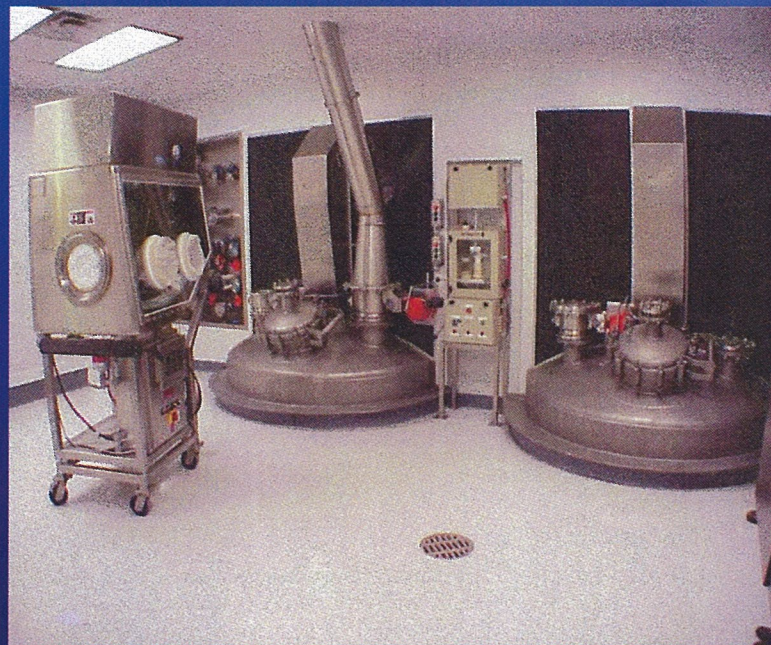
The Poppy is the Foundation of the Opiates Business



Athens, GA - Plant 8

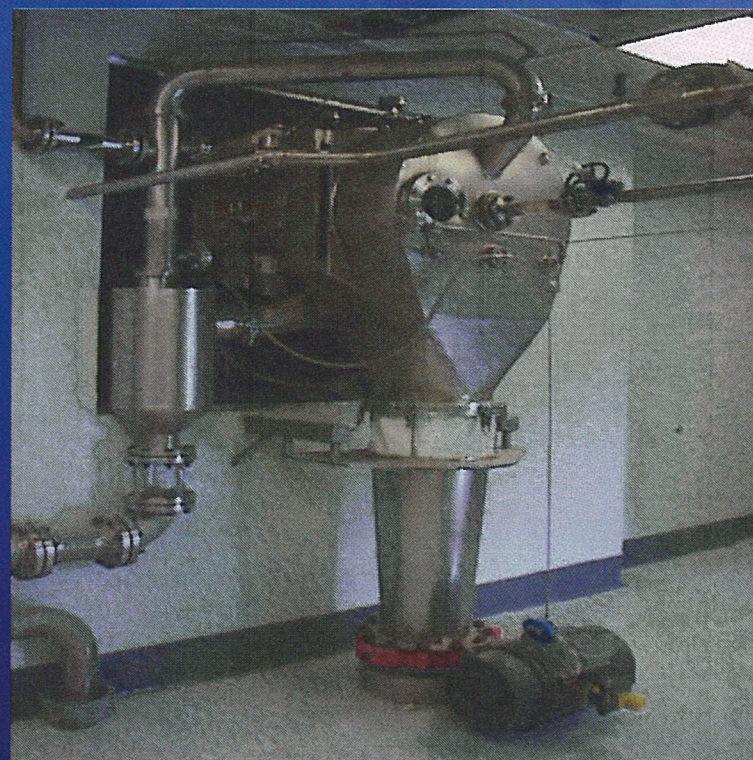
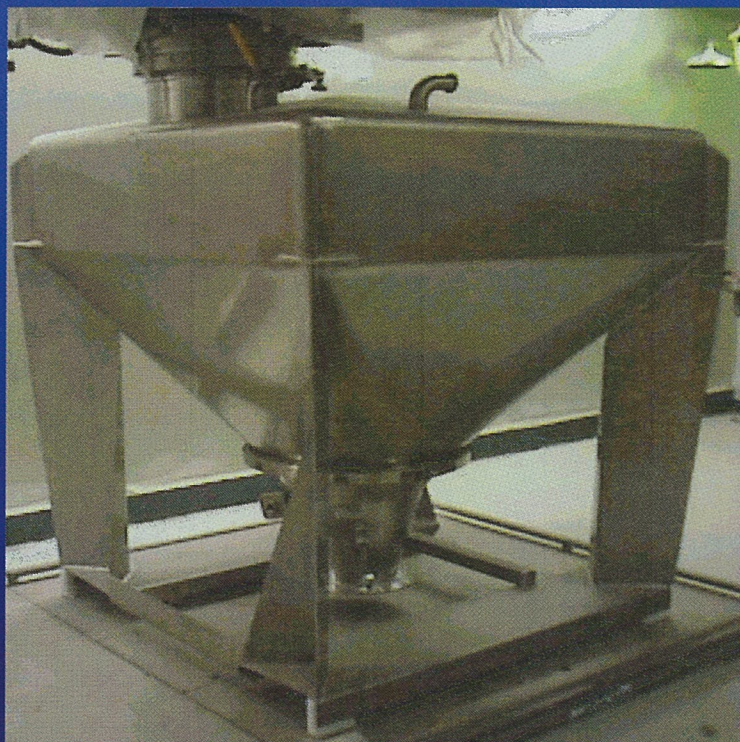
Two Large Scale Trains - Oxycodone
Hydrocodone
Vortex

Small Scale Train Validated in 2001 – Fentanyl?



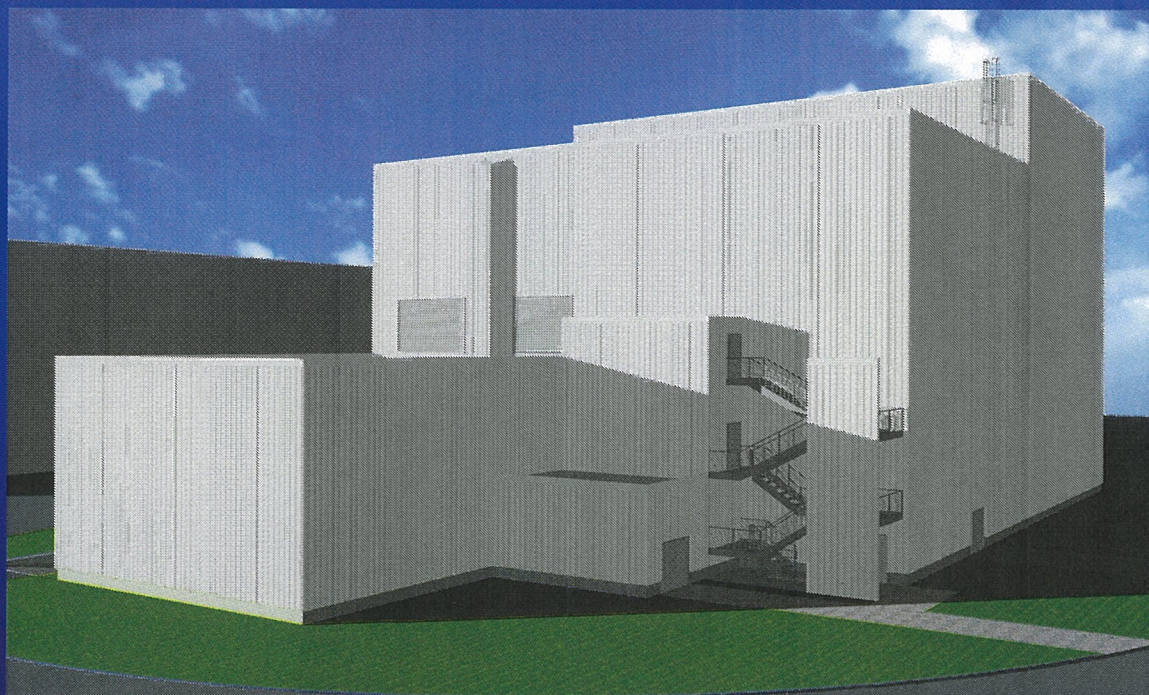
Athens Manufacturing

Athens, Georgia - Plant 8
Barrier Containment for High Potency Compounds



Facility for Super Potent Compounds Such as Sufentanil

Noramco has designed a glass scale facility suitable for production of highly potent compounds (level 3b) in quantities up to 100+kg. Appropriation will proceed if D-trans patch progresses or if other requirements develop.



Noramco / Tasmanian Alkaloids Development

- **Opiates**

Buprenorphine - Developed new 8 step synthesis

Naltrexone - Scaling up process in partnership with Cilag

- **APIs**

Tilidine - Developed new synthesis

Sufentanil – Janssen developed new synthesis for our use

- **SURGICELL**

Process used freon and would violate the Montreal convention.

Noramco developed new process and built a new facility to run it.

Noramco/Tasmanian Alkaloids Regulatory Compliance

cGMP

Worked closely with J & J Corporate Quality & Compliance Services to develop compliance systems considered among the best in J&J

FDA inspections in Athens (1999, 2002) resulted in no 483 findings

FDA inspections in Wilmington (2001) and Tasmania (2001) resulted in first-pass PAI approvals

Environmental

Athens and Wilmington sites were among the first in J & J to receive ISO 14000 recognition.

Safety

Wilmington and Athens were awarded OSHA VPP Merit status

Noramco/Tasmanian Alkaloids Summary

Market Focus

Global participant across a wide range of products, companies

Regulatory expertise

Technology

World leader in opiates technology

Development capability – alone or in partnership

Supply Chain Excellence

Strong Compliance

High potency compounds

Intranet: <http://library.pharma.com/directory/>

Located in Connecticut

-----Original Message-----

From: Sackler, Jonathan

Sent: Thursday, February 07, 2002 7:02 AM

To: Sackler, Dr Mortimer; Sackler, Mortimer JR; Mahony, Edward; Albright, Edward; Sackler, Beverly; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco- Mallinckrodt

If I understand this idea, we would contribute the Rhodes facility + ~\$700mill in cash to acquire Mallinckrodt, then we would take the company public. I don't think Mallinckrodt is the property to stretch for. Another idea would be to contribute the Rhodes facility and essentially no cash in exchange for a minority interest in what we hope will become a publicly traded Mallinckrodt. I don't think that works for us either. Let me point out some facts.

1. While the people at Rhodes are making a strong attempt to develop a book of outside business, at the moment there is none.
2. To the best of my knowledge, Mallinckrodt is not facility-constrained.
3. The only concrete value Rhodes brings to Mallinckrodt is Purdue's oxycodone requirement.
4. We are relying on Mallinckrodt to supply a lot of oxycodone this year, but down the road the bulk of our demand will switch to Noramco's inexpensive thebaine. From what I gather, because of their ownership of the super-poppy, Noramco enjoys a huge cost advantage in thebaine.
5. Ed has played these 2 suppliers off against each other very skillfully, extracting price concessions from Mallinckrodt while lining up Noramco. I don't think we want to expose our position to Mallinckrodt, but at the moment they are destined to be a much smaller part of our future supply.
6. Selling the Rhodes facility to Mallinckrodt for some minority position in their stock will return us to the status of a passive customer buying from a duopoly. If we try to lock Mallinckrodt in to a low price, then we're severely limiting the value we bring to the deal. In fact, the cost we expect to achieve with Noramco's thebaine is probably close to Mallinckrodt's cost.
7. With all the regulatory challenges in Totowa, Ed has been asked to devote himself 100% to that operation until we're out of danger. I don't think we want to ask him or his team to lead a Mallinckrodt due diligence.

8. We're trying to build solid, long-term relationships with Par and Mylan. If they learned we were contemplating selling out to Mallinckrodt, those discussions might be compromised.

9. We have a couple of key people (Kupper and Shamblen) working very hard to create a business at Rhodes. I think we want to keep them focused on our strategy to build a business on several key customers, first and foremost Purdue.

10. I don't think anyone imagines we want to invest substantial cash to hold a controlling position in Mallinckrodt.

Doing a deal like this will involve a huge amount of work, expense and exposure. I don't think this is the one to pursue.

Jon Sackler

One Stamford Forum | 201 Tresser Boulevard | Stamford, CT 06901

Telephone (203) 588-7200 | Fax (203) 588-6500 | Email jsackler@pharma.com

Assistant: Alicia Laing (203) 588-7202 alicia.laing@pharma.com

-----Original Message-----

From: Sackler, Dr Mortimer

Sent: Thursday, February 07, 2002 5:09 AM

To: Sackler, Mortimer JR; Mahony, Edward; Albright, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco- Mallickrodt

I would appreciate , if the B Directors agree, that Morti Jr's proposal be explored with an agreed Merchant Bank Group if Morgan Chase is ruled out for any reason. This would put the Rhodes operation on an independant fiscal footing and help reduce the risk for the future. I believe we now have close to 100 mio invested.

The environmenta question that has been raised in re the plants involved will have to be isolated in some way.

-----Original Message-----

From: Sackler, Mortimer JR

Sent: Wednesday, February 06, 2002 11:10 PM

To: Mahony, Edward; Albright, Edward; Sackler, Dr Mortimer; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

What if we had Rhodes purchase Malinckrodt Pharmaceuticals, and then take the combined entity public to pay off/down the debt? I am sure this could be structured with the right investment banker, if it made sense to do. Tyco should be willing to sell the business at a reduced multiple to what could be achieved in a public offering, because it would enable them to generate liquidity faster and would be a cleaner split/transaction for them. This would mean that with the addition of the Rhodes business and the discount on the purchase we could end up owning a substantial portion of the equity of this large business while taking a very small equity risk ourselves. I would imagine this whole deal being financed completely separate from Purdue.

Do others believe that this is worth studying out and exploring further?

Regards,

Mortimer

-----Original Message-----

From: Mahony, Edward

Sent: Wednesday, February 06, 2002 3:30 PM

To: Albright, Edward; Sackler, Dr Mortimer; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

I agree with Ed Albright. We have limited capacity to raise new money, while staying within our current private structure. I would not use our limited capacity to buy Mallinckrodt's narcotic business.

Best regards,

Ed

-----Original Message-----

From: Albright, Edward

Sent: Wednesday, February 06, 2002 1:59 PM

To: Sackler, Dr Mortimer; Mahony, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

Mallinckrodt met with us yesterday at Totowa. Tyco plans to spin out 4 businesses from Tyco, including Heath Care (including Mallinckrodt). Mallinckrodt's sales are in the \$800 million area. The financial methodology for these "spin offs" were a little confusing, but we were told they would issue 4 separate IPO's (supposedly at 20% value). Bottom line is we will not have any raw material shortages from Mallinckrodt in 2002 (we plan to purchase 17 tons this year). There may be issues beyond 2002, but both Rhodes and Noramco can easily replace all of Mallinckrodt's volume in 2003 and beyond. I'm sure Tyco would entertain a buyout for Mallinckrodt, but am not sure they would respond favorably to only buying a piece of the business. The \$800 million sales (even at only a 1X multiple) seems out of our range and there are certainly environmental issues in the St. Louis plant.

-----Original Message-----

From: Sackler, Dr Mortimer

Sent: Wednesday, February 06, 2002 12:05 PM

To: Mahony, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Albright, Edward; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

Thanks Ed Mahony for the news analysis.

Ed Albright: Are we exposed to a possible raw material production shortage if Mallinckrodt's parents or siblings put it into a fiscal mess. Will Rhodes be able to make up for shortages? When does Rhodes enter the supply chain for oxycodone

Michael et al: Could we negotiate to buy Mallinckrodt with a payout overtime or would such an idea not be helpful to Tyco?

-----Original Message-----

From: Mahony, Edward

Sent: Wednesday, February 06, 2002 3:52 PM

To: Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Mortimer; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Albright, Edward; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: Tyco

Colleagues,

FYI . . . Tyco (parent of Mallinckrodt, a major supplier to Purdue) has been under a microscope in the financial markets lately. Dan Colucci summarizes below some of the recent news. A few years ago we briefly discussed buying Mallinckrodt. In my view, a purchase of Mallinckrodt financed by debt would not be viable at this time.

Ed

-----Original Message-----

From: Colucci, Dan
Sent: Tuesday, February 05, 2002 11:36 PM
To: Mahony, Edward; Suffredini, Michael
Subject: Tyco International--some information
Importance: High

Here is some information on the their recent troubles. It is very complex and I gave it a quick read. As you know, they own Mallinckrodt.

Chronology first:

--Shortly after 1/01/02, their stock was at \$59.00 with a market cap of \$118.0 billion. At that time they began to be hit with rumors of poor accounting. This was not good in light of Enron. It was not the first time rumors had swirled.

--On January 22, with the stock drifting downward, they announced they would split into four companies to unlock shareholder value. The shares jumped back to \$50.00.

--In late January, the stock fell further as bonus amounts to the Chairman, high consultant fees to auditors, and a \$20.0 million consulting fee to a director and a charity are announced.

--On 2/1 it was announced they had made \$8.0 billion in acquisitions without disclosing them during 2001. They said they were immaterial in light of the size of the organization.

--2/4 S&P cuts their senior unsecured debt from A to BBB, two notches above junk, and their CP rating from A1 to A3, one notch above junk. Tyco Capital (the old CIT Finance, an asset-based lender recently acquired by Tyco) is cut from A+ to A-. Tyco International, fearing the CP markets will be cut off from them, borrows on their \$5.9 billion line of credit to pay \$4.0 billion in commercial paper. On 2/5 Tyco Capitol also draws on its lines of credit to retire debt.

--2/5 Market Cap \$46 billion.

Here is a summary of recent results. On paper, what is happening does not seem warranted. One might argue, however, that the financials are meaningless due to the accounting rumors. In addition, given the state of the market, even if the numbers are valid it doesn't seem to matter. The news has made it impossible for them to borrow in the CP market affecting liquidity and borrowing rates. Given the debt load, they were going in the wrong direction.

--For the year ended 9/30/01, they earned almost \$4.0 billion on sales of \$36.4 billion. This compared to earnings of \$4.5 billion on sales of \$30.7 billion as of 9/00.

--They had total assets of \$111.3 billion at 9/30, and total debt of \$79.0 billion. All of the fiscal 2001 acquisitions increased debt by \$56.0 billion from 9/00 to 9/01. Cash from operations at 9/01 was \$6.7 billion, from investing <\$11.6 billion>, and from financing \$6.3 billion, bringing the total cash balance at 9/01 to \$2.6 billion.

--For the quarter ended 12/31, they earned \$1.4 billion on sales of \$10.1 billion. Cash balances stood at \$3.2 billion, while total debt grew slightly. They are projecting "\$4.0 billion in free cash flow" for the year, although during the first quarter it was <\$215.0 million> due to spending at one company. They also projected earnings guidance of \$3.70/share for fiscal 2002.

--The division Mallinckrodt is included in has a number of companies, had 9/01 sales of \$8.8 billion, and operating income of \$1.8 billion. We know Mallinckrodt had sales itself in 1999 of \$2.6 billion.

Message

From: Sackler, Dr Richard [/O=PURDUE/OU=EXTERNAL
(FYDIBOHF25SPDLT)/CN=RECIPIENTS/CN=3AFB14348C50493E95A6A5977146F48E]
Sent: 2/7/2002 8:02:29 AM
To: Sackler, Jonathan [/O=PURDUE/OU=EXTERNAL
(FYDIBOHF25SPDLT)/CN=RECIPIENTS/CN=EDCD012C2FCA40ECA986A3580BECA1AE]
Subject: RE: Tyco- Mallickrodt

It was great

But the one on point was even better.

Richard S. Sackler, M.D.

Laptop 2000 machine #7777-01

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Stamford, CT 06901

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Located in Connecticut

-----Original Message-----

From: Sackler, Jonathan
Sent: Thursday, February 07, 2002 7:40 AM
To: Sackler, Dr Richard
Subject: RE: Tyco- Mallickrodt

but did you like the other email? best i've done in years, if you ask me.

Jon Sackler

One Stamford Forum | 201 Tresser Boulevard | Stamford, CT 06901
Telephone (203) 588-7200 | Fax (203) 588-6500 | Email jsackler@pharma.com
Assistant: Alicia Laing (203) 588-7202 alicia.laing@pharma.com

-----Original Message-----

From: Sackler, Dr Richard
Sent: Thursday, February 07, 2002 7:35 AM
To: Sackler, Jonathan
Subject: RE: Tyco- Mallickrodt

I think that you have thoroughly destroyed this idea. Now I see why you thought it was stupid.

Richard S. Sackler, M.D.

Laptop 2000 machine #7777-01

One Stamford Forum

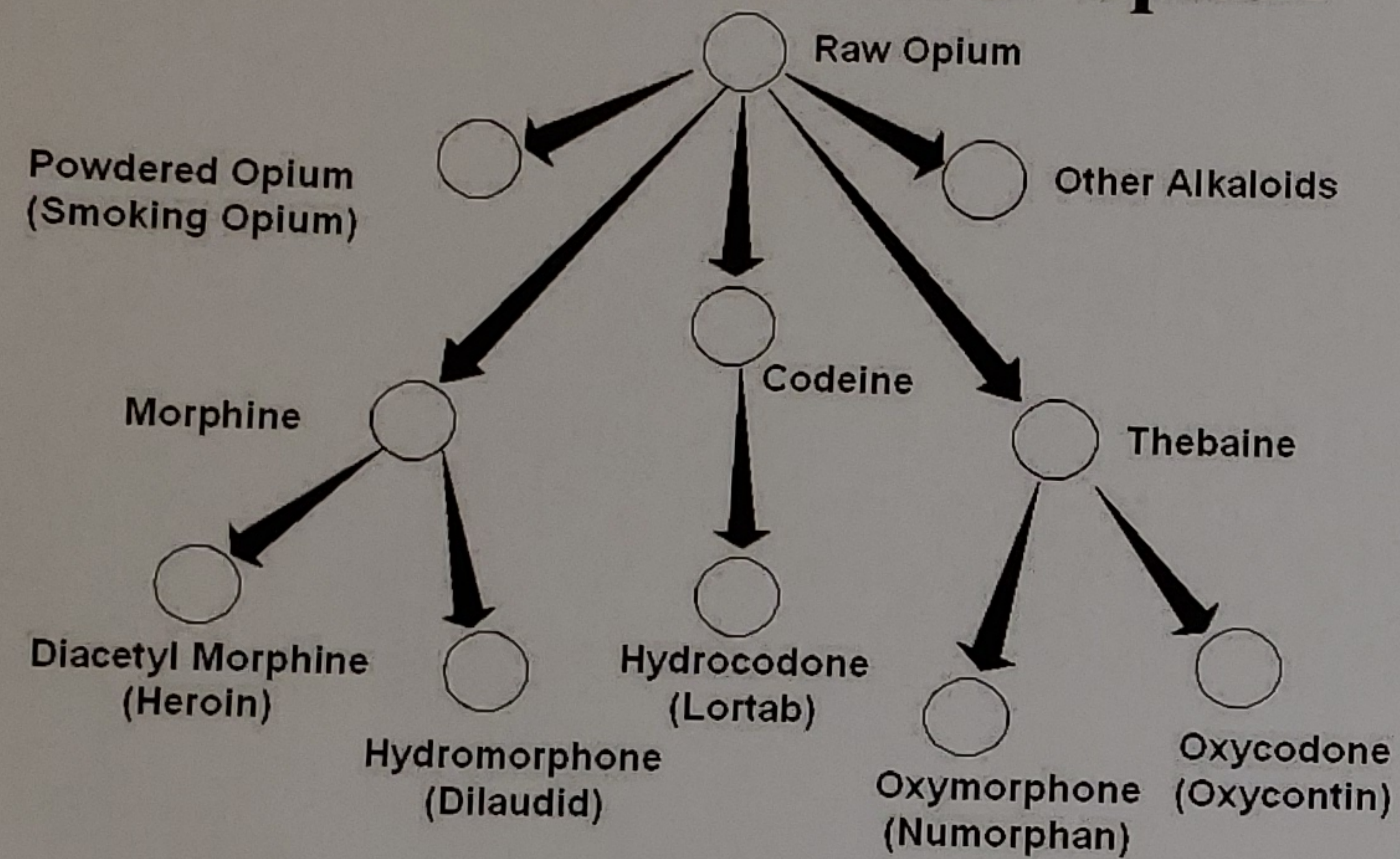
Stamford, CT 06901

Telephone 203 588 7777

PA 203 588 7779

Internet rs@pharma.com

Commonly-abused Opiates and Their Derivation From Opium



Morphine is the principal natural alkaloid of opium. It was first isolated from opium in 1805. Morphine is used medically to suppress severe pain, for example, with terminal cancer patients. It is highly addictive.

Codeine is another natural alkaloid of opium, separate from morphine. Codeine was first isolated in 1832. It is used medically to suppress coughing or minor pain. Although codeine is an analgesic, its pain killing ability is much weaker than morphine's. Codeine definitely is addictive. NOTE: The technical name for Codeine is Methyilmorphine.

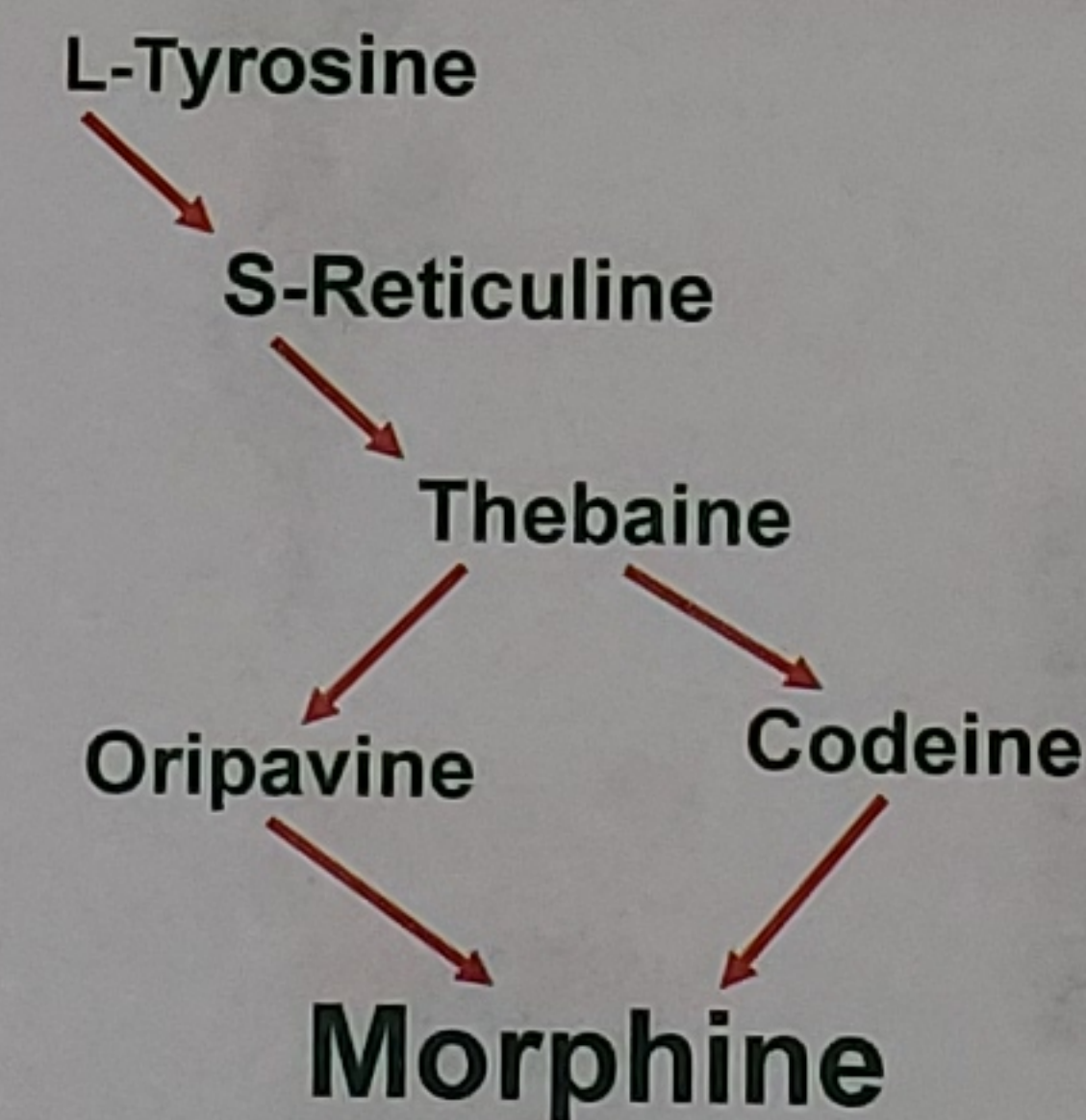
Heroin is an Opium Derivative that is produced by chemically treating Morphine. Heroin is the most commonly abused illicit Narcotic Analgesic. Heroin was first produced in 1874, in the hope that it would prove to be a

Narcotic Raw Materials Revolutionary Changes

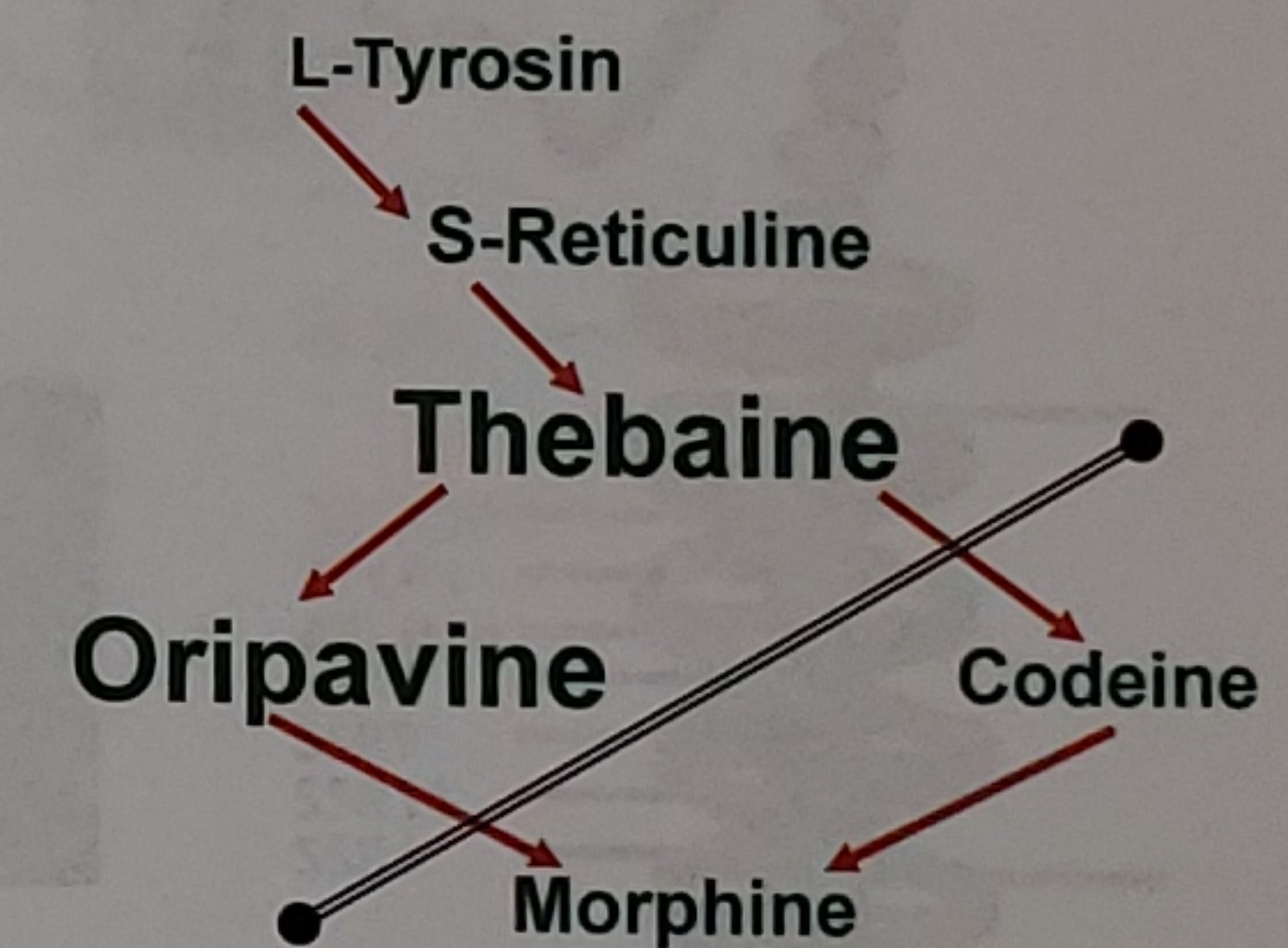


Tasmanian Alkaloids' Patented (1998) Poppy Made it the World's Largest Supplier of Thebaine and Oripavine

Natural Synthetic Pathway



Transformational Poppy "Norman"

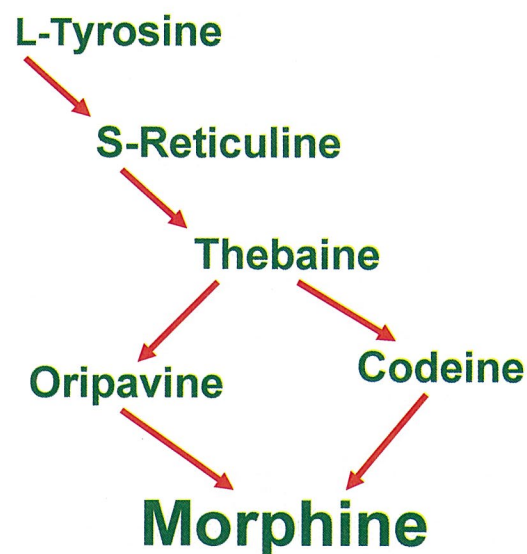


The "Norman" poppy was developed with advanced breeding techniques - not genetic engineering. It was the foundation of the growth of OxyContin and oxycodone IR.

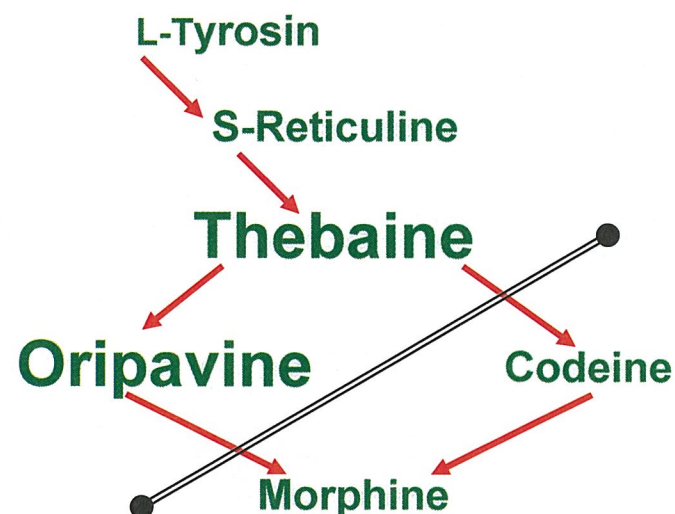


Tasmanian Alkaloids' Patented (1998) Poppy Made it the World's Largest Supplier of Thebaine and Oripavine

Natural Synthetic Pathway



Transformational Poppy “Norman”

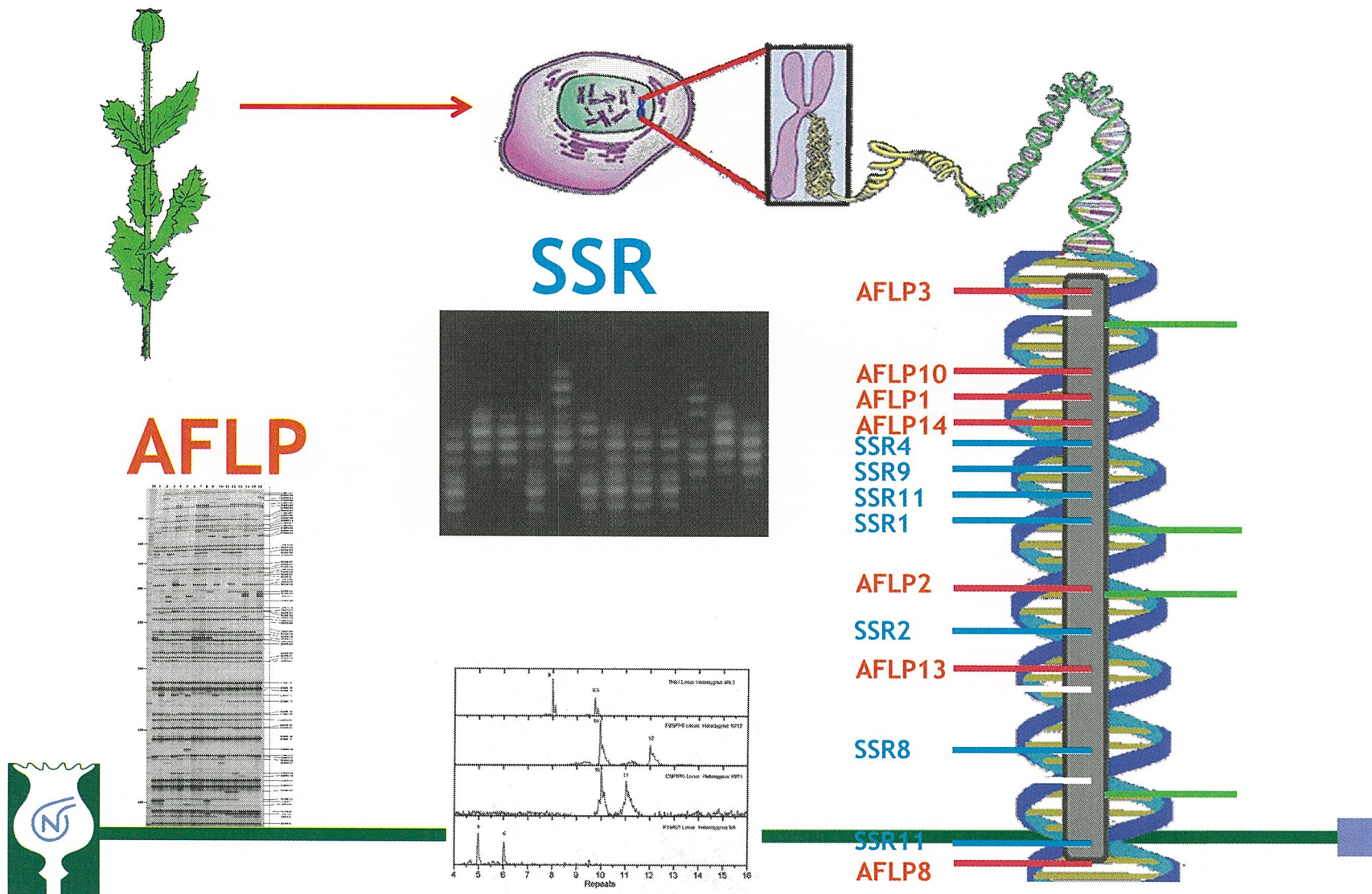


The “Norman” poppy was developed with advanced breeding techniques - not genetic engineering.

It was the foundation of the growth of OxyContin and oxycodone IR.



TasAlk Has Taken a Scientifically Sophisticated Approach Molecular Markers- Mapping Commercially Significant Traits



Access to Thebaine

The rapid growth of thebaine demand has made supply very tight

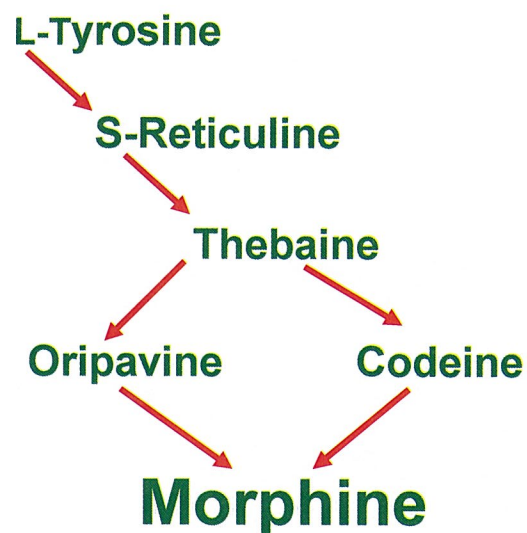
- Tasmanian Alkaloids supplied about 75% of the world's requirements
- Internal API requirements account for about 60% of that total.
The remaining 40% supports the requirements of all other major producers



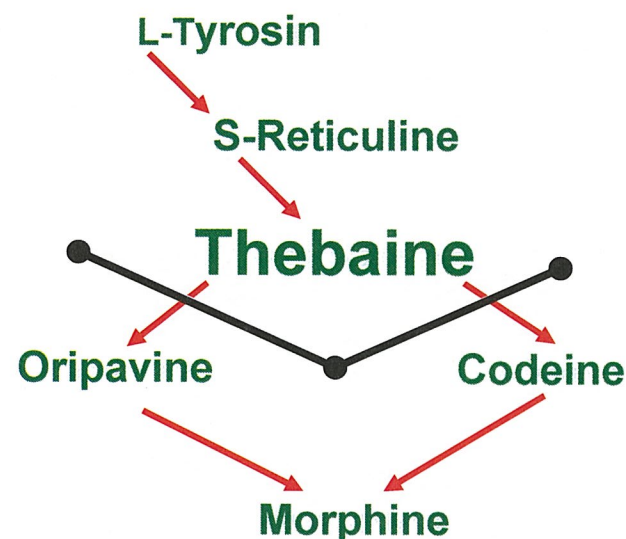
Confidential

Tasmanian Alkaloids' Patented (2008) All Thebaine Poppy Will Improve Capacity and Security of Supply

Natural Synthetic Pathway



Advanced Thebaine Poppy “TED”



“TED” is the successor to Norman and will be the base of all production in 2010 - significantly increasing capacity.



Access to Morphine

The Morphine market can be unstable

- The INCB limits entry by countries into poppy cultivation
- The INCB and member states limit stocks for control purposes
- As an agricultural product, there are periodic crop failures

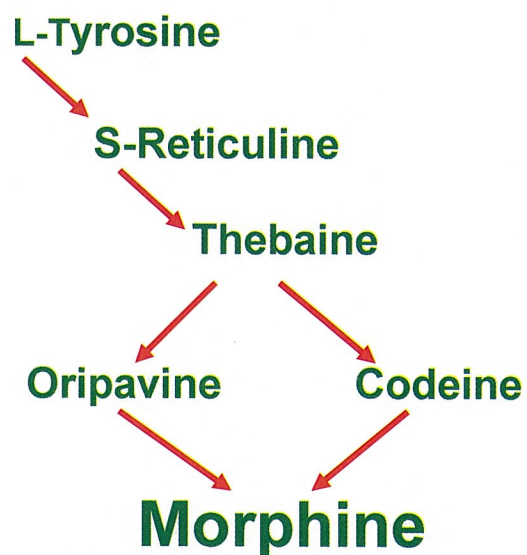
Severe shortages periodically occur

- 1970's - Turkey's withdrawal from opium led to severe shortages. Codeine supply placed in jeopardy
- 1998/1999 - India had a severe crop failure in 1998 following a failure in Turkey the previous year. The Department of Defense liquidated its strategic stockpiles to avert a crisis
- 2010 - Low pricing in prior years coupled with thebaine demand crowding out morphine has led to a significant shortage.

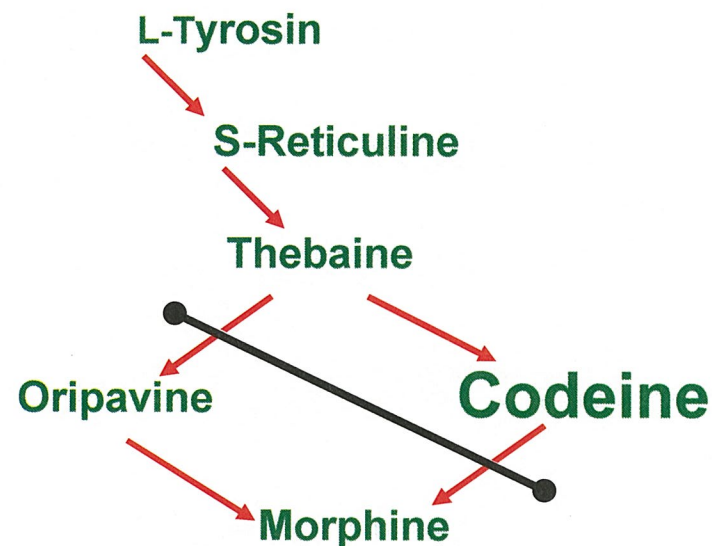


Tasmanian Alkaloids' Patented (2009) Codeine Poppy Will Have a Major Impact on Global Codeine Market

Natural Synthetic Pathway



Codeine Poppy “TASMAN”



Use of natural codeine welcomed by Home Office, US DEA and INCB because it is less abusable than morphine.

Offers an option to morphine that will greatly enhance security of supply



“Tasman” - Supply of Codeine Phosphate

**2009 - Harvested ~2 hectares. Small scale extraction trials
Lab scale process development**

**2010 - Harvest poppy to support ~ 9 tons CPH
Complete process development
Produce codeine base to support commercial scale validations**

2011 Validate new process at sites in US, Europe

End 2012 - Commercial supply



NALs - The Next “Big Thing” ?

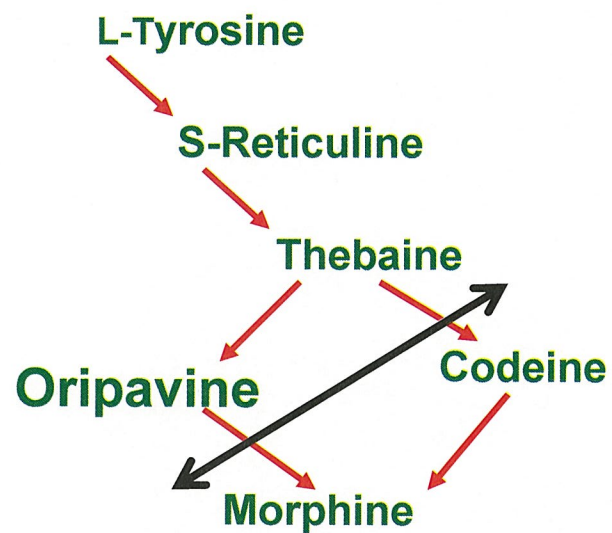
Oripavine is the ideal starting material for NALs (naltrexone, naloxone, methylnaltrexone, nalbuphine, nalmefene)

Oripavine demand could grow rapidly with new NAL applications for obesity, constipation and abuse deterrent combination products

- Tasmanian Alkaloids is the leading supplier
- We have a new poppy (“Eve”) with very high oripavine content that will secure supply for API customers



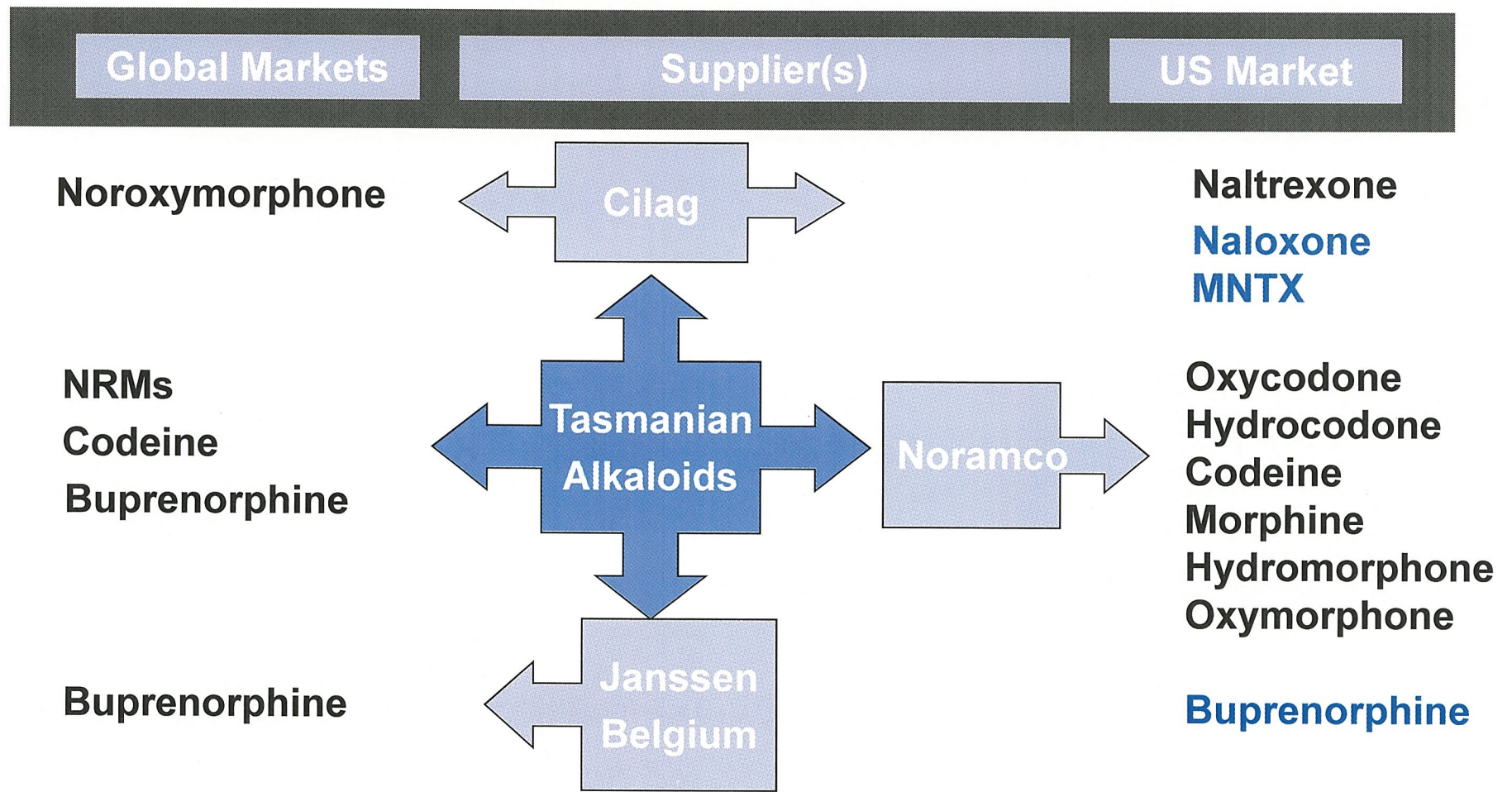
TasAlk Is preparing for the Growth of NALs With the development of “Eve”



We expect to plant “Eve” in 2010 to support 2011 demand



Noramco's Supply Chain is Founded on the Base Of Tasmanian Alkaloids Poppy Technology



Confidential

Thank You

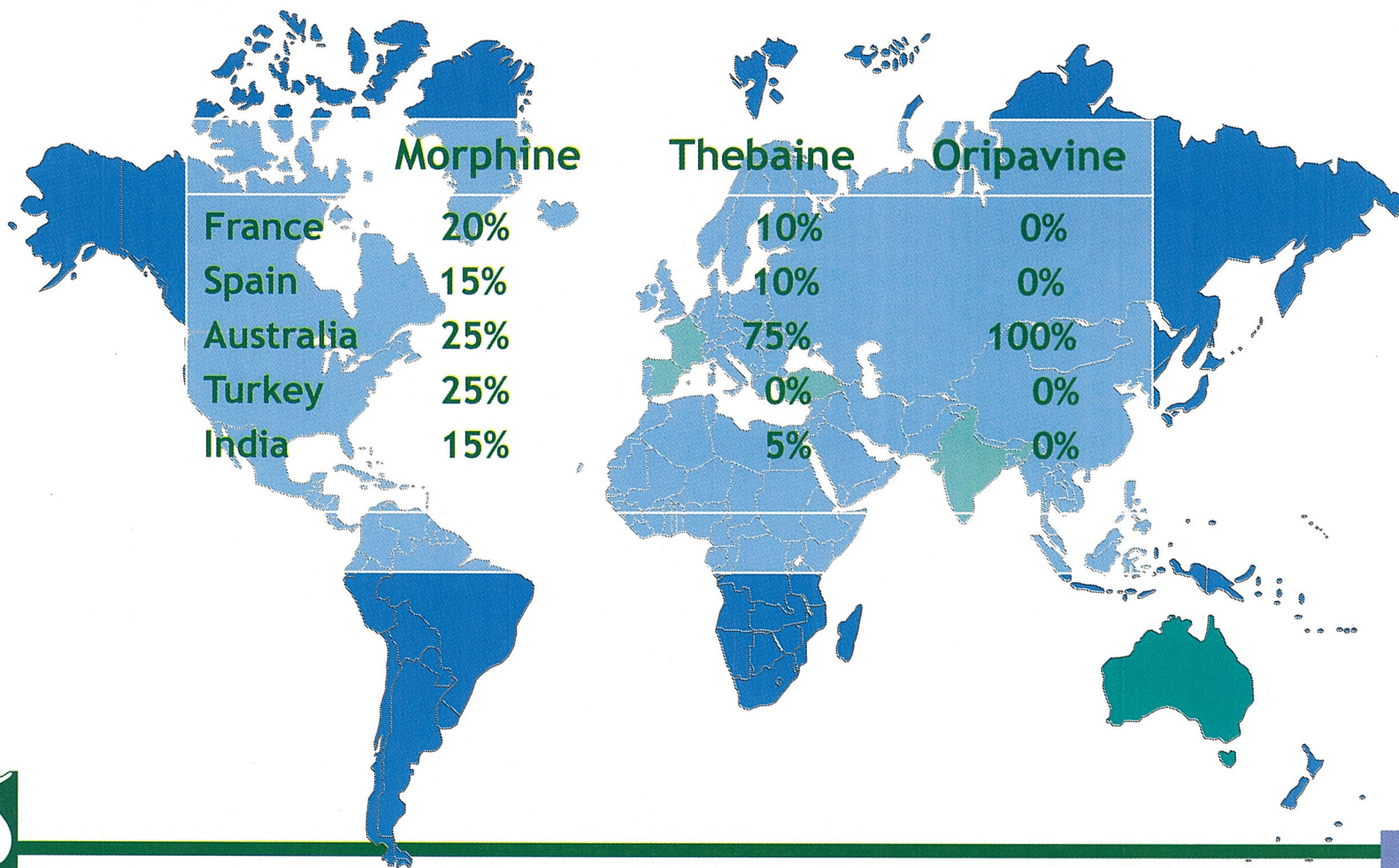


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Narcotic Raw Materials Global Market

Morphine ~ 400 MT

Thebaine ~ 150 MT



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Narcotic Raw Materials Revolutionary Changes



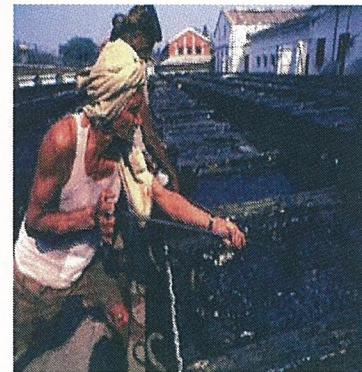
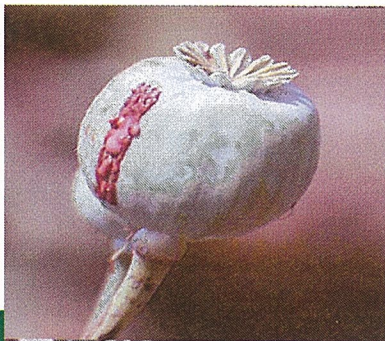
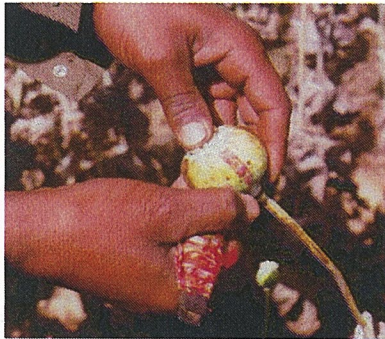
Johnson & Johnson



Opium is the Traditional Source of Morphine

Gum opium is about 10-12% morphine, 3% codeine and 2% thebaine

It has been smoked, eaten and dissolved in alcohol for hundreds of years to treat pain, control diarrhea and euphoria



Opium Fueled the Massive Boom of the Early 1800's

In the mid 1700's England's insatiable demand for tea led to a balance of payments deficit with China that was depleting the Treasury's silver reserves

In 1782, the first ship left India for China to sell 27 tons of opium (2.5 tons morphine). The cost was £500. They had to dump it in Maylasia for £340.

After this initial failure, the business grew dramatically:

1806 -	350 tons or about	42 tons of morphine
1835 -	2,300 tons or about	260 tons of morphine

The balance of payments deficit was turned into a huge surplus.
Opium taxes accounted for 15% of England's tax revenues
Moral concerns were "overcome".



Market Changes - Development of APIs 1835 to 1980's

Market was transformed from direct consumption of opium to APIs

Morphine isolated in 1820's and hailed as a substitute for opium that would eliminate the problem of addiction.

By 1981, the API market had transitioned to codeine with morphine as starting NRM.

Small amounts of another NRM -thebaine - were required for oxycodone

	Consumption in Tons		
	US	ExUS	Total
Codeine	49	110	159
Morphine	0.5	3.5	4
Hydrocodone	1	0	1
Oxycodone	1.5	0	1.5



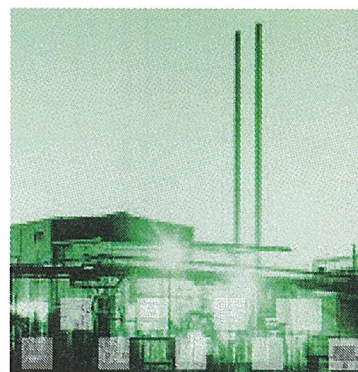
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NRM Changes - Development of CPS 1835 to 1980's

Purer NRMs became available with the development of a commercially viable extraction process by Janos Kabay in the 1930's.

Poppy heads are harvested and brought to a factory where the alkaloids are extracted in a manufacturing setting producing a much purer NRM

Turkey converted production from opium to CPS and new NRM producers were established primarily France and Australia.



1980 to Present The US API Market Has Been Transformed

The growth of strong opioids usage has transformed the API market

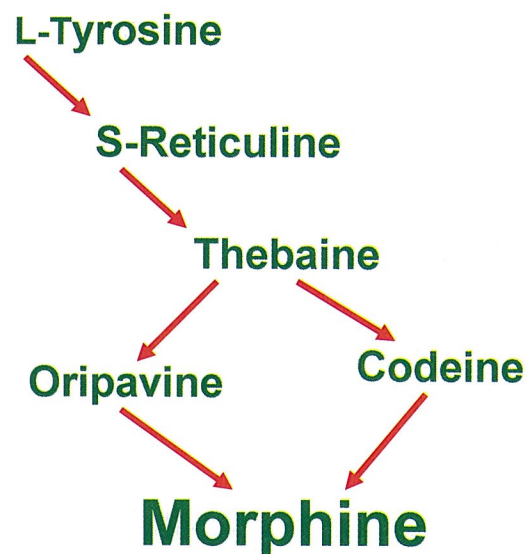
US Consumption in Tons (Base)			
	1981	2007	
Codeine	49	24	Morphine
Morphine	0.5	23	Morphine
Hydrocodone	1	30	Morphine → Thebaine
Oxycodone	1.5	42	Thebaine

US demand for thebaine has surpassed that of morphine



The Transformation of the API Market Required A Transformation of the NRM Market

Natural Synthetic Pathway

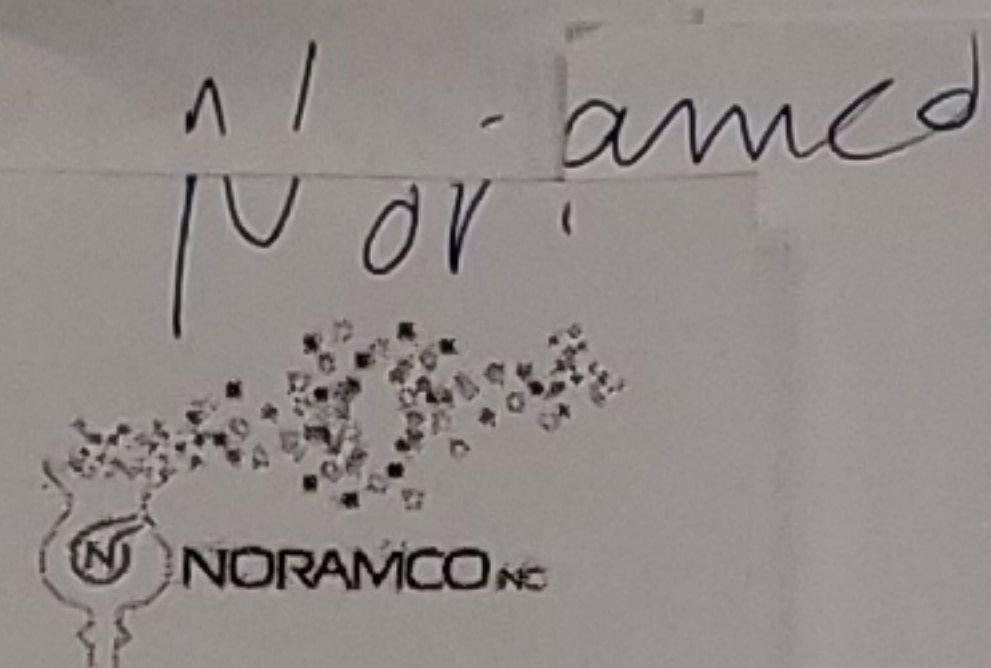


The poppy produces morphine very efficiently
Codeine and thebaine are normally by products

Thebaine is the ideal NRM for oxycodone and hydrocodone. However, Thebaine was only available as a by product of opium. It was destroyed in CPS processing.

Oripavine is the ideal starting material for NAL compounds . It was not commercially available.





Franchise Strategy

- Leverage our vertical integration to deliver the best cost, highest quality, controlled substance APIs
 - Codeine from Tasman poppy
 - Partner with best-cost technology focused manufacturers
- Enter new markets for existing products
 - Target closed markets by supplying API to customers
 - Strategic countries and regions of interest for existing portfolio
- Maintain a leadership position in agricultural R&D
 - Increase alkaloid content to generate capacity and lower costs
 - Breeding programs to assure robust and stable crops
- Participate in growth through partnerships

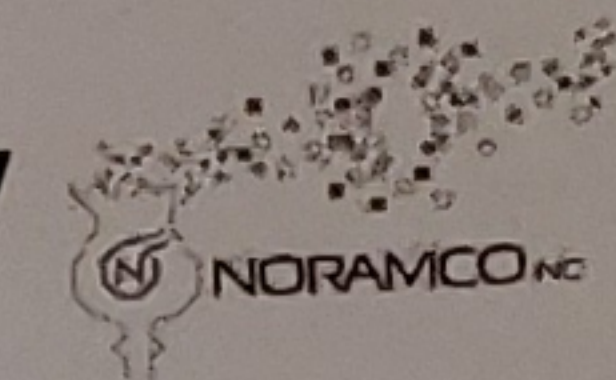


Focus. Execute. Deliver.

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Over 80% of Noramco's Sales are via Long-Term Supply Agreements



Noramco has long-term agreements and/or majority controlled substance share with all 7 of the top US generic companies

Typical supply agreement terms

- Covers multiple controlled substance products (4 or more)
- Agreements are for more than 80% of customer's volume
- Terms are for 3 to 5 years minimum with rolling renewals

Note: Existing agreements are not a guarantee of future business or renewal, purchaser must assess value

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Opportunity For Purchaser



Acquire the #1 supplier of Narcotic APIs in the United States, the world's largest market

Gain a **global presence** with marketing authorizations filed in 30+ countries

Inherit a **strong pipeline** of new products and filed customer product opportunities

Become a **key supplier** to the world's largest multi-source generics

Acquire fully integrated **facilities and personnel** and **external supply network**



Wilmington, Delaware
Active Pharmaceutical Ingredients



Westbury, Tasmania
Extraction, Ag R&D



Athens, Georgia Building 6
Small Scale Manufacture + R&D

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PAR_OPI

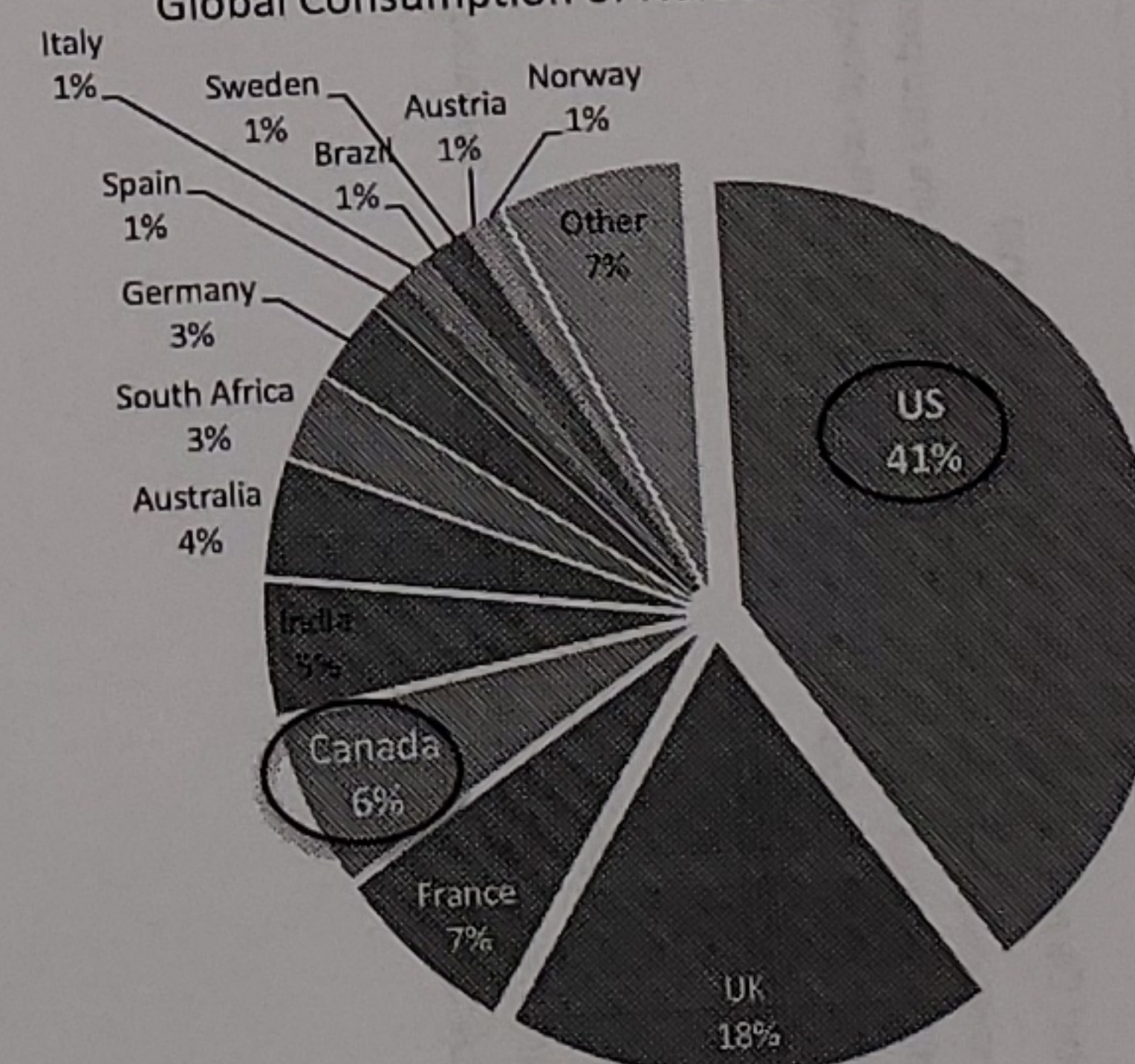
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J+J #1 Supplier

North America is 47% of Global Consumption and is The Key Controlled Substance Market



Global Consumption of Narcotic Controlled Substance



North America consumes:

- 82% of the world's Oxycodone
- 99% of the Hydrocodone
- 99% of the Oxymorphone
- 79% of the Hydromorphone
- 66% of the Buprenorphine
- 61% of the Morphine
- 14% of the Codeine

Source: IMS FY 2014
Includes OXY, HBT, CPH, PMS, OMH, HMM, NLX, NTX, BUP.
Excludes synthetics and ADHD/ADD drugs

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USA MAJOR PLAYERS
VERTICAL INTEGRATION

	Finish Dosage				
Company	Tab	Liquid	CS II APIs	Poppy Straw Products	Fields
Shire	✓				
Reckitt Benckiser	✓	?			
Novartis	✓	?			
J&J	✓	✓	✓	✓	✓
Purdue	✓		✓		
Teva	✓	?			
UCB	✓				
GSK	✓			✓	✓
Watson	✓	✓			
Covidien	✓	✓	✓	✓	✓
Global Pharma (Impax)	✓				
Mylan	✓				
Sun	✓	✓	✓	✓	✓

6

Vertical Integration

Tasmanian Super Poppy

Tasmanian Alkaloids

Super Poppy - resulted in production of more mmse/pa poppy

- allowed for growth of oxycodone

- Patented high thebaine poppy (Purdue)
was a trans formatel technology that enabled the growth oxycodone
Dr Fut awarded a Johnson Matthey

- Extra patent

- Endo - oxycodone?

- Generic oxycodone

Agenda

OxyContin Planning Meeting
Thursday, June 10 - Merritt 7 (Conf. Room M1)
2:00 PM - 5:00 PM

Agenda Topic	Presenter	Duration
1) Revised Forecast - \$/Units/Month (1999/2000) <ul style="list-style-type: none"> > Buy-in Assumptions/Y2K > Price Increase (Amount/Timing) > 2000 Projections 	Jeff Zerillo	2:00 - 2:30
2) Raw Material Supply Status/Outlook (1999/2000) <ul style="list-style-type: none"> > Review Shortages (Opium) <ul style="list-style-type: none"> • Mallinckrodt Delivery Plan • Capacity Increases (Synthetic) • New Crop • Noramco Delivery Plan • Super Poppy • Capacity Increases • Regulatory (FDA) Approval • Johnson Matthey <ul style="list-style-type: none"> • Technical Difficulties • Thebaine For Mallinckrodt • Capacity Limits '99 • Regulatory (FDA) Approval 	Ed Miglarese	2:30 - 3:15
3) Production Plan/Supply Issue (1999) <ul style="list-style-type: none"> > Monthly Production Plan (Inc. Var. From Forecast) > Unit Inventory - Month End > Monthly Kg. Required (Inc. Var. From Forecast) > Monthly Kg. Received/Usable > Kg. Inventory 	Jeff Zerillo	3:15 - 3:45
4) Aggregate/Quota Issue <ul style="list-style-type: none"> > New DIP - Aggregate Quota Plan > Mfg. Quota Status 	Barbara Stedje	3:45 - 4:15
5) Capacity/Through Put (1999/2000) <ul style="list-style-type: none"> > 3rd Shift/New Capital - Bump/Pkg. Line/Compression > 2000 Requirements 	C. Hildenbrand CH	4:15 - 4:45
6) Action Plans - Next Steps	All	4:45 - 5:00

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Super Poppy

Agenda

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6) Action Plans - Next Steps	All	4:45 - 5:00

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Minutes/Action Items

OxyContin Planning Meeting
Thursday, June 10 - Merritt 7 (Conf. Room M1)
2:00 PM - 5:00 PM

In Attendance:

Albright, Ed.
Alfonso, Mark
Fogel, David
Friedman, Michael
Green, G.R.
Hane, Jeff
Hildenbrand, Chuck
Mahony, Ed
Migliarese, Ed
Sears, Terri
Seltzer-Claudio, Marla
Stedje, Barbara
Temple, Maurie
Zerillo, Jeff

The objective of the meeting was to review the current DIP forecast (Oxy=\$675M), and develop an understanding of the supply, capacity, aggregate and quota issues, and how we can optimize these situations in the best way with a contingency plan. We will have progressive increases in supply driven by crop and supplier capacities. We will review two plans: one for the base case that reflects deliveries of 10.2 tons of oxycodone, and the 2nd plan, which reflects where we will be if the planned supply is reduced to 9.2 tons. The second plan will require the most time and attention because sales timing could create backorders.

We discussed a variety of ways to handle the dynamics of supply, capacity and growth of the business, all of which are reflected in the notes. There are some immediate action items, which support our strategy; however, more importantly we agreed to meet every six-(6) weeks to review the business and relative issues so that we can alter our strategy accordingly as a group.

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Key Responsibilities (Tasks/Actions)

1. Revised Forecast - \$/Units/Month

We looked at buy-in assumptions, price increase (amount/timing), RX Vs. DIP and the Y2K assumptions.

We are currently scheduled for a price increase effective Nov. 1. We must define how many months of supply (MOS) we want the buy-in to be. M. Friedman indicated that there are some financial implications, wherein we want to be paid prior to the end of the December. There is some concern about wholesalers' using Y2K problems as an excuse for not paying their bills. The intent is to get away from year-end collection of money. We must also consider what our last ship date in '99 should be in order for Finance to be comfortable with receiving payments before the end of the year. E. Mahony expressed that he would rather we be prepared to ship whenever we are ready to supply the customer, as necessary. The key element to our strategy is to manage our plan so that we have product to ship to the customer, with little or no customer service issues. The following suggestions were made:

- M. Friedman proposed that we could get the price increase orders ahead of time, and propose to our customers' that we ship one (1) month of orders over a period of time. (M. Friedman)
- M. Friedman proposed that our price increase be effective Nov. 1, with an October buy-in and some carry-over.
- G. R. Green proposed that we sell the price increase and Y2K issues together in order to manage the sales/inventory and supply. (G. Green)
- Mark Alfonso shared with the group that the wholesalers' indicated that they would buy between 20% over the normal purchases to manage the Y2K issues. Mark indicated that they would be circulating this report shortly. (Mark Alfonso)
- Quantity - The question was posed whether we should plan for 3 months of supply on a base case buy? M. Friedman suggested that we work with 2 months, with a price increase proposed for November 1. We should ramp up in August, with September/October build. This should allow for 2 months more than demand. This plan should reflect that the fastest rates of growth are the Oxy 40 and 80mg.

Quota Limitations

Ed Albright indicated that we must also consider quota limitations, which are calculated using a formula based on historical sales. If you go to the DEA with actual orders, they may recognize them. Therefore, the earlier we have the orders from the field, the easier it will be to get DEA to increase quota. EA suggested we obtain orders from the wholesalers in August. Another idea that was made by G.R. Green, was to propose to the wholesalers that we take a price increase in August and ship in Nov. It will be critical to receive these wholesaler's orders in August in order to secure DEA quota to bring in the required raw material from Mallinckrodt. (G.R. Green)

EA indicated that the next 4-5 months appear to be forecasted conservatively, and this may create problems for factory planning and raw material supply. Mark Alfonso will analyze the April and May data, monitor weekly and communicate the scrip rates accordingly. (M. Alfonso)

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It was also mentioned that validation batches of Oxy 160 may be too short to sell due to expiration dates of Oct. '00, if approval is not received by September/October of this year.

2. Raw Material Supply Status/Outlook

We reviewed the shortages (Opium) and looked at delivery plans and strategy for key raw material suppliers (Mallinckrodt, Noramco and Johnson Matthey). Ed Miglarese reviewed the world supply for opiates and discussed what PF has done and will do to manage this issue. Our '99 requirement of 10 tons is based on our original budget (\$582M); with the new forecast @ \$673M, this has increased to 12 tons.

Michael Friedman and Mark Alfonso are planning extensive market research with the physicians and patients to understand Oxy sales upside for the mid-term (2 - 3 years). The curve shows continued exponential growth.

Strategic Supply Decisions

We have some significant strategic decisions to consider in terms of capacity and supply amongst the three suppliers. We should also look at the DIP numbers, capacity, quota, etc. for our future narcotic products. (Marketing/Totowa Group)

It was suggested that we should consider launching some other SKU's to increase our consumption of raw materials. Michael Friedman inquired if it would be in our best interest to increase our supply requirements and long-term (future year's) commitments. Ed Miglarese indicated that this is already being done.

Mallinckrodt

They will be able to supply 12 1/2 to 13 tons by the end of the year. We will determine Mallinckrodt's capacity based on our commitments to them. In general, we must begin sending signals to our suppliers of our requirement of 17 tons for '00, so that they can begin planning their capacity and raw material requirements. (Ed Miglarese)

Palladone XL

Michael Friedman inquired about PF's ability to launch Palladone earlier than expected. CH indicated that if we all agreed on a plan, PF could probably meet an earlier launch date. A critical factor is obtaining sufficient quota to match the launch and future sales within 1999.

3. Production Plan/Supply Issues

OxyContin Supply Vs Demand Analysis

Jeff Zerillo expressed some concern about short-term supply across the board beginning with April, with May being a critical concern. The issue is the timing of certain events that will allow us to support the sales and certain stocks. For this to work, all of the following are contingent to our plan:

- Mallinckrodt's commitment of an additional 330 kilos a month starting in August through

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December.

- Thebaine
- We are expecting 110 kilos from Noramco to ship to Mallinckrodt in May, and expect 400 kilos of Thebaine in July to ship from Noramco to Mallinckrodt. However, we are dealing with suppliers that have been less than predictable.
- **Issues/Strategy**
- We should make a decision on the price increase in August, and inform the Board accordingly.
- There is some jeopardy in July and August according to the current forecast.
- We must continue to manage these issues closely. However, the forecast in some cases looks a little low.
- It was suggested that Marketing/Sales review the numbers in April and May. (Michael Friedman and Mark Alfonso).
- A downside to this plan is the March 17 forecast and resulting months of supply (units).
- Actions that we can take in August -- announce that we will not take a price increase until mid-2000.
- Michael Friedman proposed that we prepare a spreadsheet that assumes that we do not have a price increase (straight demand forecast) allowing us to manipulate it based on supply. (Mark Alfonso)
- Strategically we have to clear the decks to throw all our capacity towards Oxy. JZ is proposing building MS Contin inventories so that we can better manage the Oxy production. (Jeff Zerillo)

It was communicated that the '99 MS Contin projected sales is \$100M, or \$120M if Endo is not successful. Mark Alfonso indicated that forecasting models would be updated weekly in order to more effectively manage the business. (Mark Alfonso)

Mark Alfonso proposed that we stay with \$140M DIP so that we have material available. Marketing will review the numbers. The actual factory demand will be about \$100M, but it could be as much as \$120M if the competitive strategies are effective. Michael Friedman proposed that the DIP number should be \$120M. Michael Friedman indicated that he has no problem with building inventory to \$140M to free up capacity for Oxy. The issue with this plan is quota. DEA has given us 4000 kilos, and we probably won't have the sales to support a quota increase. EA indicated that we could support production to \$120M.

4. Aggregate/Quota Issues

The DEA has not seen our requirement of 12,000 tons. This is an issue in terms of quota that they will offer. We should not use the business as usual method. We should contact the DEA and communicate that this is not a trailing number, and that Y2K and growing business justifies the need to support an increase. (Ed Miglarese/Barbara Stedje)

We should monitor our sales Vs. quota in May and June before going to the customers' with a price increase proposal. This will enable us to manage our process more effectively.

Ed Albright suggested we run a quota calculation without the buy-in to see what the shortfall will be. (Barbara Stedje)

G.R. Green proposed going to our five (5) key customers and working out a Y2K plan. G. R. would bring this plan back to all involved. (G. R. Green)

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5. Capacity/Through Put

Chuck presented his plan, which takes into account running MS Contin up front and clearing the decks for Oxy. To manage this growth (sales/capacity), PF is reviewing the need to purchase additional coating and compression equipment ASAP.

As we conduct our 5-yr. plan, and revisit our 5-yr capacity plan based on the sales numbers, we must build flexibility into our plan based on the upside/downside sensitivity analysis. (Chuck Hildenbrand)

EDLA

As we head into the launch, we can maximize our price based on our capacity. Michael Friedman and Mark Alfonso will look at this area more closely to effectively plan strategy. Marketing will conduct some price sensitivity studies in each application, and have a meeting with PF to share the models. (M. Friedman and M. Alfonso)

Laboratory Capacity Plan

Jeff Hane indicated that there would be no bottlenecks in QC based on his strategic plan in the Lab, due to his teaming and dedicated equipment strategy.

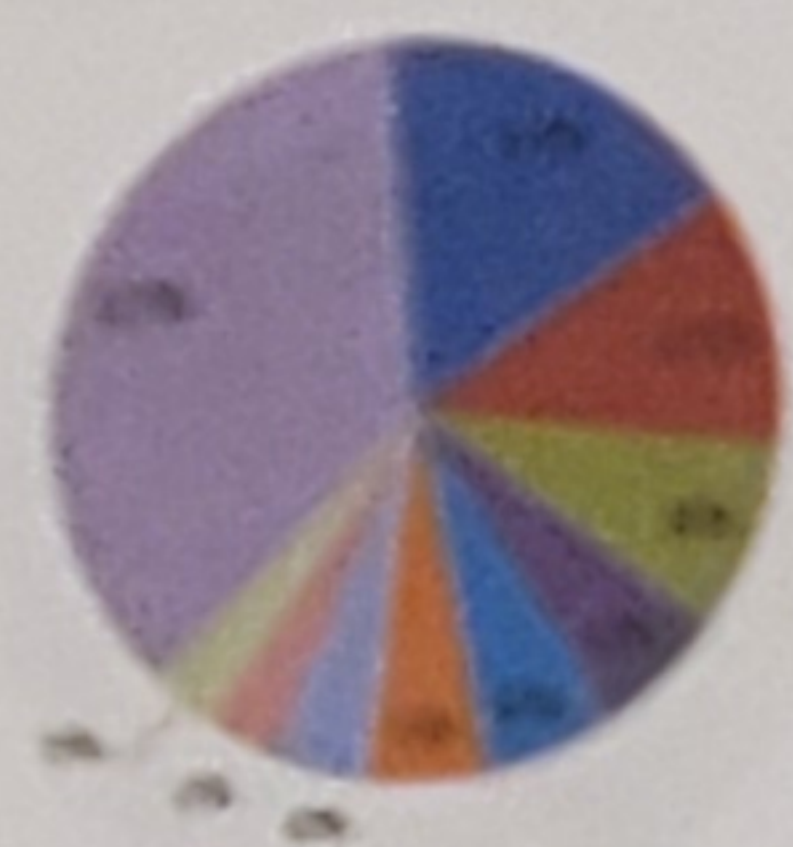
6. Next Steps

- Schedule a 6-week cycle for these meetings to review if our suppliers are still able to deliver the upside schedule we discussed at the meeting. (Ed Albright/Michael Friedman)
- The issues discussed at this meeting should be presented to The Board in an hour or less. The next Board meeting is scheduled for April 30. Michael Friedman will arrange to have this subject put on the agenda. (M. Friedman)
- Some of the key issues that should be presented to The Board are:
 - Headcount/Operational Expenses
 - Supply Issues Vs. Growth of Business
- The Totowa group will arrange to have all relative information ready for the Board meeting by mid-April. (All Totowa Meeting Attendees)

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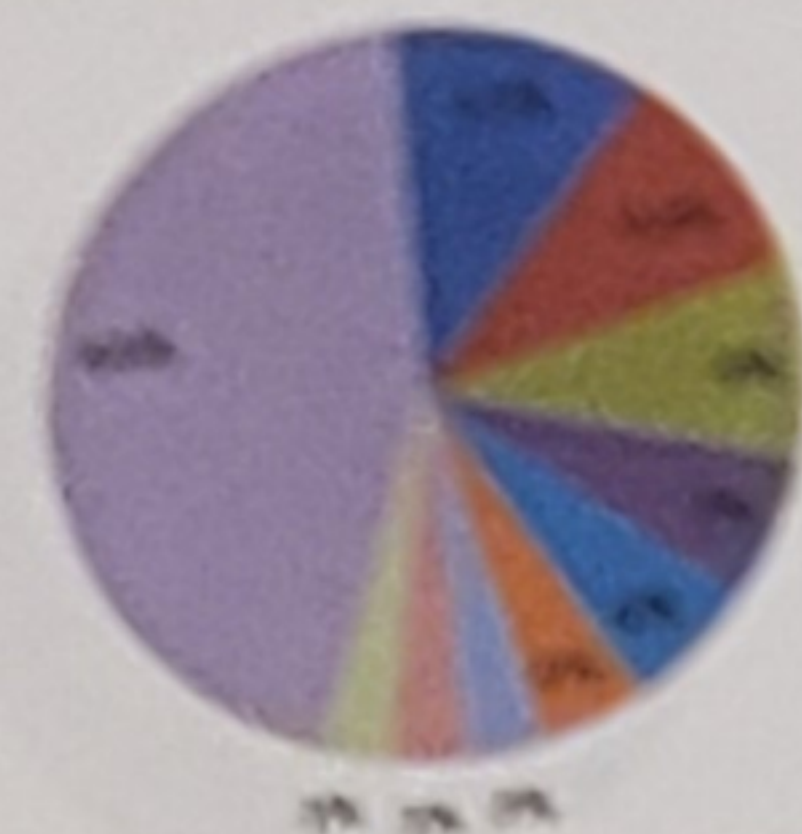
API - Top 10 Customers (FY13)

FY13 API Top Customers by Sales



Actavis
Nesher
Alvogen
Aurobindo
KVK-Tech
Nalco
Purdue
Rhodes
Teva
Viatris

FY13 API Top Customers by Margin



Actavis
Nesher
Alvogen
Aurobindo
KVK-Tech
Nalco
Purdue
Rhodes
Teva
Viatris

- FY13 Sales of \$166M, Margin \$51M
- Actavis Contract expired. Pursuing new business (oxycodone, methylphenidate)

Controlled Substances Business - 20,000 Feet

Value Proposition / Positioning

Capitalize on our expertise and capabilities in controlled substances and highly regulated markets. Leader in all of the "Core Four" areas of differentiation.

Major Products:

- Fentanyl Family
- Hydrocodone
- Nal Product Line
- Oxycodone Family
- Methadone

Main Customers:

- Watson
- BioCringer Ingelheim
- Mylan
- Teva

Main Competitors:

- J&J Noramco
- Johnson Matthey
- Purdue Rhodes
- Francopia

Challenges/Threats:

- Reliable low cost competitors squeeze profitability
- Cost pressures on customers
- Misuse of pain management products

Opportunities:

- Further innovation with product line
- Reduction in costs due to Project Pinnacle/STLP Master Plan
- Global market expansion - increase percentage of controlled substance sales to >25%

API Controlled Substance Competitive Landscape



Note: Name in bold represents company which imports narcotic raw materials as well

100% or before 2000 To 2004 After 2004

Controlled Substance API Key Initiatives

- Margin Enhancement by transition away from lower margin products
 - Aggressive marketing of oxycodone into the market with increased plant capacity in order to diversify customer base
 - Actavis, Nesher, Alvogen, Aurobindo, KVK-Tech
- Pushing buprenorphine into ANDA filings
 - Par, Aveva/Apotex
 - Push to have Reckitt transition buprenorphine for suboxone to MNK supply
- Methylphenidate:
 - Price increases passed through to all customers in FY14.
 - Capture Actavis/Impax volumes for launch of generic Concerta.
- NAAs:
 - Recapture Alkermes business lost in 2009
 - Renewal of Orexigen contract
 - Naltrexone price increases for current business with Intas, BMS and Mylan
- Methadone: BI moving all volume to MNK by FY15.

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Controlled Substance API Key Initiatives



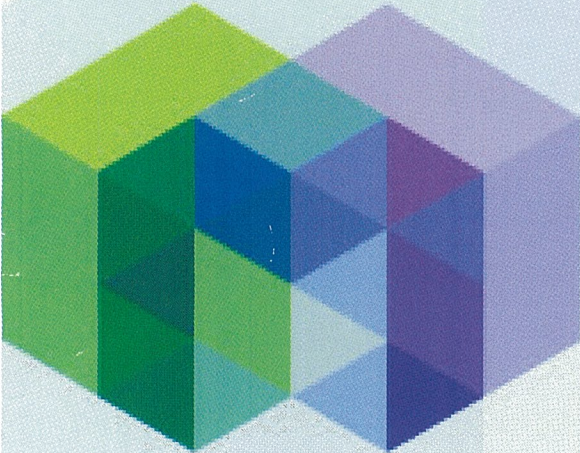
- ▶ Continued Customer Product code transitions to free up STLP line time and simplify production.
- ▶ Regulatory working closely with the FDA to allow for CBE type filings for STLP process changes.
 - ▶ CBE 0 filing change for hydromorphone transition.
 - ▶ FDA currently reviewing hydrocodone and methylphenidate changes.
- ▶ Key Focus Products
 - ▶ Nalbuphine 3310 to 3360 transition (target completion by FY15)
 - ▶ Hydromorphone 3245 to 3222 (target completion by FY16)
 - ▶ Methylphenidate 1571 - 0570 (target completion by FY16)
 - ▶ Sufentanil 3310 and 0672 to new codes(TBD)
 - ▶ Hydrocodone 1582 to 1559 (TBD)
 - ▶ Noscapine from CPS

Controlled Substance API Focus Areas



- New Product/NDA and Pre-NDA work. Higher margin products to fill the API development pipeline.

Product	Customer	Product Code	Sales (MM)	Summary
(+) Naltrexone HCl	University of Colorado/Xalud	New Product	\$1.7	Xalud has been granted a DOD research grant using (+) naltrexone for treatment. Initial request for 10kg to be produced in the FY15 timeframe
Levorphanol Analog	Phoenix Pharmalab (PPL)	New Product	\$1.6	PPL working on a levorphanol analog which they claim will be 20 times more potent than morphine, non addictive, and will not result in GI tract issues. MNK to produce material for additional IND studies in the FY14/FY15 timeframe.
DATSCAN intermediate	GE Healthcare	New Product	\$2.8	Proposal has been sent to GE for MNK to produce cocaine intermediate for GE.
D-Methadone	Relmada	New Product	\$0.6	Relmada in Phase II development of product for treatment of neuripathic pain.
Levorphanol Base	Mylan	New Product		Mylan performing initial testing for development for a levorphanol patch.
Levorphanol	Relamda	0545	\$0.6	Relmada in Phase II development of product for treatment of neuripathic pain.
Nalbuphine	Trevi Therapeutics	3360	\$0.4	Trevi is in phase II/III trials of a product for treatment of pruritus associated with treatment of dialysis.
Total			\$7.7	



Controlled Substances FY15 Strategic Plan

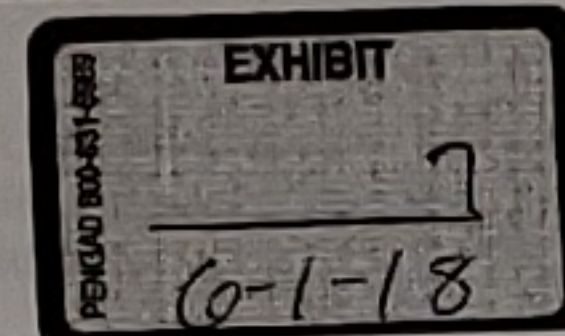
January 16, 2014



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The Tasmanian Poppy Industry: A Case Study of the Application of Science and Technology

A.J. Fist
Tasmanian Alkaloids Pty Ltd, Westbury, Tasmania.



increased at 50-100% per annum, and it now comprises more than 60% of the crop contracted to Tasmanian Alkaloids. Norman produces approximately the same quantity of alkaloid per hectare as conventional varieties, but as thebaine and oripavine instead of morphine.

The development of the Norman poppy coincided with the release of a slow release formulation of oxycodone in the USA. Oxycodone is used in treatment of strong pain, mostly in terminally ill patients. The new formulation was very successful, and there was greatly increased demand for the thebaine raw material used for its manufacture. The high demand has caused an increase in crop area in India, as well as allowing growth of thebaine crop area in Tasmania. The Indian production however has caused an overproduction of morphine, which is likely to depress prices for both morphine and codeine.

This new poppy variety is a major turning point in alkaloid production. For the first time, thebaine can be produced efficiently without concomitant production of morphine. High alkaloid *P. somniferum* poppies can be grown without risk of diversion for illicit purposes: thebaine and oripavine are not easily converted into morphine or heroin. Thebaine can be converted into codeine, which is currently the largest volume API produced from opium alkaloids, so perhaps virtually all the world's opium alkaloids will eventually come from poppies having the Norman mutation.

This innovation, like most of the plant breeding projects in the poppy industry, had virtually no input from the public sector. The ideas developed from discussions in Tasmanian Alkaloids and Johnson & Johnson Research, a J&J Company based in Sydney. It drew on the expertise of analytical chemists, geneticists and agriculturists within the companies.

Discussion

In the early stages of the industry, DPIWE took a leadership role in much of the agronomic research for poppies. Poppy nutrition, irrigation requirements, responses to lime, optimum densities, and crop protection methods were determined by work conducted at government research stations. This research laid an important foundation for the industry. Plant breeding research has been the province of the processing companies since the industry's inception.

Farmers have been involved in a number of important innovations. In the beginning it was a matter of necessity: the crops had to be harvested! Farmers are still involved in innovation, but perhaps in a more incremental way. Recently, individual farmers have been recognised for developing improved crop-lifters for harvesters, enabling harvest of lodged crops (8), and for inventing a rapid method of adjusting wheel spacing for drills used in raised-bed paddocks (9). Two recent innovations have been adopted from other crops or areas. Raised bed farming was adopted from Victoria by farmers working together in the Southern Farming Systems organisation. Use of raised beds has been critical in increasing Tasmania's poppy crop area to the current levels. Centre pivot and lateral move irrigation systems were adopted very slowly initially. DPIWE conducted research in the late 1980s showing that water could be applied more evenly through these systems than through the more common gun irrigators. Assistance given by the potato processing company, Simplot, to farmers to purchase centre pivots appears to have been the critical step that precipitated widespread adoption. Farmers now are often purchasing these systems primarily for use on poppy crops.

Developments in crop protection and nutrition over the last 15 years have been lead by the poppy companies on a background of information developed in the public sector in the earlier years. The poppy companies now lead and initiate virtually all the poppy research undertaken in Tasmania, and the public sector is a very minor part of the picture. The major focus of the companies is on plant improvement. Development of higher yielding varieties have been critical in the survival of the industry against countries where the poppy industry is used as a rural support scheme.

The research model used in the poppy industry is quite different to others in Tasmania and Australia. The research is fairly applied and very market focussed. Virtually all of the poppy research conducted in Australia is done by company personnel or directly funded by the companies. Research corporations such as HRDC support a small number of projects in relatively non-competitive areas such as disease research. Farmers do not pay levies, and have a minor role in the direction of research. However, due to the close

Intranet: <http://library.pharma.com/directory/>
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Original Message

From: Sackler, Jonathan

Sent: Thursday, February 07, 2002 7:02 AM

To: Sackler, Dr Mortimer; Sackler, Mortimer JR; Mahony, Edward; Albright, Edward; Sackler, Beverly; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco- Mallinckrodt

If I understand this idea, we would contribute the Rhodes facility + ~\$700mill in cash to acquire Mallinckrodt, then we would take the company public. I don't think Mallinckrodt is the property to stretch for. Another idea would be to contribute the Rhodes facility and essentially no cash in exchange for a minority interest in what we hope will become a publicly traded Mallinckrodt. I don't think that works for us either. Let me point out some facts.

1. While the people at Rhodes are making a strong attempt to develop a book of outside business, at the moment there is none.
2. To the best of my knowledge, Mallinckrodt is not facility-constrained.
3. The only concrete value Rhodes brings to Mallinckrodt is Purdue's oxycodone requirement.
4. We are relying on Mallinckrodt to supply a lot of oxycodone this year, but down the road the bulk of our demand will switch to Noramco's inexpensive thebaine. From what I gather, because of their ownership of the super-poppy, Noramco enjoys a huge cost advantage in thebaine.
5. Ed has played these 2 suppliers off against each other very skillfully, extracting price concessions from Mallinckrodt while lining up Noramco. I don't think we want to expose our position to Mallinckrodt, but at the moment they are destined to be a much smaller part of our future supply.
6. Selling the Rhodes facility to Mallinckrodt for some minority position in their stock will return us to the status of a passive customer buying from a duopoly. If we try to lock Mallinckrodt in to a low price, then we're severely limiting the value we bring to the deal. In fact, the cost we expect to achieve with Noramco's thebaine is probably close to Mallinckrodt's cost.
7. With all the regulatory challenges in Totowa, Ed has been asked to devote himself 100% to that operation until we're out of danger. I don't think we want to ask him or his team to lead a Mallinckrodt due diligence.

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JAN-MS-03117381

Super Poppy
Case History

increased at 50-100% per annum, and it now comprises more than 60% of the crop contracted to Tasmanian Alkaloids. Norman produces approximately the same quantity of alkaloid per hectare as conventional varieties, but as thebaine and oripavine instead of morphine.

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relationships between the companies and the growers, the growers' needs are well understood and taken into account.

The market focus is one of the major strengths of the poppy industry. Researchers work together with colleagues involved in marketing and in field operations. This has the effect of keeping the research very relevant to the company's products and customers. Another strength is the strong extension effort. Approximately 30 company field officers work on a one to one basis with poppy growers, and advise on all aspects of poppy crop production. Growers are very receptive of new technology, and uptake is rapid. A particular strength at Tasmanian Alkaloids is the integrated company structure. At the one site, poppy varieties are developed, poppy straw is processed and active pharmaceutical ingredients are manufactured and marketed. This provides a tremendous depth of knowledge and experience, and a very motivational environment in which to conduct research.

A possible weakness of the current system is that due to the strong lead taken by the processing companies, the public sector has tended to consider the poppy industry as self-sufficient, and public research dollars have favored other crops. Opportunities have probably been lost as a result.

Conclusion

The Tasmanian poppy industry needs a competitive advantage in order to compete against foreign competitors who receive extensive government assistance through protected monopolies and subsidies. The high alkaloid content of the Tasmanian crop is our most important competitive advantage. Science and technology have been critical in providing this edge.

The industry has a strong commitment to research, and growers are very supportive of the research effort and readily accept new technology. Whilst most of the current research and development is lead by the processing companies, poppy growers, government research agencies, and agribusiness have all been partners in this success.

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Table 2. Scientific and technological developments important in the development of the Tasmanian poppy industry. For each issue, the background is summarised, the critical development is identified, and the organisation having the major influence on the development is indicated. The new practices are described and the beneficial outcomes are listed. The dates given are approximate.

Date	Issue	Background	Critical research/development	Major Influence	Practice	Outcome
1975	Harvesting	Grain headers found to be unsuitable due to humidity in coastal Tasmania.	Grain headers modified by farmers. Farmers also involved in critical steps in introduction of forage harvester technology.	Farmers	All modern poppy harvesters use principles developed.	Harvesting can occur in humid conditions.
1975	Morphine yields	Alkaloid yields recognised as important	Company breeding programs	Companies	New varieties regularly introduced.	Global competitiveness maintained.
1976	Boron deficiency	Known in Europe. Deficiency symptoms found in crops when area extended into alluvial soils.	Symptoms confirmed as boron deficiency. Responses shown to boron top dressing.	DPIWE	Boron applied to susceptible soil types at sowing. Where boron deficiency develops it is usually recognised and treated quickly.	Crops grown successfully on B deficient soils.
1983	<i>Pleospora</i> Control	Crop losses due to <i>Pleospora</i> .	Research shows importance of crop rotations, stubble management and seed dressings.	DPIWE	Seed dressings, 3 yr crop rotations Stubble destroyed by burning or slashing and burying.	<i>Pleospora</i> not a significant problem.
1987	Irrigation	Poppies introduced as dryland crop.	Critical times for irrigation, and demonstrated the large response to irrigation.	DPIWE	Irrigation guidelines are widely followed.	Increased yields. Increased percent of farmers use irrigation.
1990	Weed control	Inter-row cultivation found not to be satisfactory in krasnozems soils. Poppies are too small a crop for specific development of herbicides	Selective weed control programs developed. The major breakthroughs were identification of diquat as a selective herbicide for poppies (4) and the introduction of asulam / ethofumesate tank mixes (Glaxo research).	DPIWE (especially early on) Companies Serve-Ag Research	Selective herbicides used universally.	Most crops weed free. Few crops fail due to weed infestations.

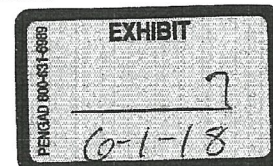
Date	Issue	Background	Critical research/development	Major Influence	Practice	Outcome
		by chemical companies.	A number of smaller advances have been made in the last 15 years, such as the introduction of Alta Adjuvant and Command (clomazone).			
1992	Nitrogen nutrition	Work by DPIWE showed favourable responses in many circumstances.	Establishment of critical sap nitrate concentrations.	DPIWE + Tasmanian Alkaloids	Company field officers test sap nitrate and recommend N top-dressing accordingly.	Higher and more consistent alkaloid %.
1996	Thebaine yields	Thebaine produced as a byproduct of morphine extraction. Increasing requirement for thebaine.	High thebaine varieties developed with no morphine	Tasmanian Alkaloids	Thebaine specific crops grown and extracted	Supply of high quality thebaine to market without concomitant production of morphine.
1997	Downy Mildew	Downy mildew became a widespread and serious threat to poppy crops	Identification of the disease, development of protective and eradication strategies (using downy mildew strategies in other crops as a model).	Companies, Serve-Ag Research	Widespread use of spray programs.	Reduced losses to this disease.
1998	Raised beds	Need to increase poppy area. Controlled traffic research done by DPIWE.	Adoption of technology from Victoria	Southern Farming Systems ¹	Approx. 2500 ha of poppies grown on raised beds in 2000/2001 season.	Increase in amount of land available for poppy crops. Increased yields due to earlier plantings and improved drainage.
1998	Centre Pivot irrigation	Gun irrigators recognised as being uneven. Growers looking to efficiently irrigate larger areas	Potato companies encouraged use of centre pivot irrigation. The technology was then used on other crops in the rotation.	Potato companies	Centre pivot and lateral move irrigation in widespread use, often in conjunction with raised beds	Higher yields. Lower labour requirements.

¹ Southern Farming Systems is a farmer controlled RD&E organisation.

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Abstract

Tasmania is the world's largest producer of opium alkaloids for the pharmaceutical market. The area sown to poppies is close to 20,000 ha, and the industry is one of the larger employers in the State.

The application of science and technology has been critical to the development of the poppy industry. High yielding varieties and efficient production methods allow the Tasmanian industry to compete successfully on the world market.

Farmers, government research agencies, and the processing companies have each been important in the development of new technology for the poppy industry. In recent years, the activity of government research agencies has declined and their role has largely been replaced by private enterprise.

The strengths of the industry include its strong market focus and the close relationship with poppy growers.

Key Words

poppy industry development alkaloid opium

Introduction

This paper discusses the role of science and technology in the poppy industry from the perspective of one scientist who has been involved in the industry since 1981. While this perspective may be considered somewhat narrow, the limited geographic spread and relatively short history of the industry assist an individual to provide a reasonably complete and balanced view. Because of its commercial nature, many of the statements made and work reported in this paper are not supported in published papers.

The Tasmanian Poppy Industry

The Tasmanian poppy industry is based on the opium poppy, *Papaver somniferum* L. This annual herb is one of the oldest cultivated plants known to mankind and the history of the human race is interwoven with the use and abuse of this plant (1).

Cultivation of poppy crops is restricted to Tasmania by ministerial agreement between the Commonwealth and the States. The industry is characterised by a high degree of vertical integration. The processing companies, Tasmanian Alkaloids and Glaxo Wellcome, are involved in agricultural research and provision of seed and advice to farmers, through to manufacture of active pharmaceutical ingredients (APIs). Each company contracts with about 700 farmers on an annual basis. At maturity, the dry crop is mechanically harvested, and transported to the processing plants. Growers are paid according to the alkaloid content of their crop, which provides a strong incentive for growers to maximise alkaloid yields. During processing, the crop is threshed to separate seed from poppy straw. The alkaloids are extracted from the poppy straw to produce concentrate of poppy straw (CPS), which can be sold as a narcotic raw material, or utilised in the manufacture of APIs. Concentrate of poppy straw generally contains between 40 and 80% alkaloid, with that produced in Australia at the upper end of the range. Tasmanian Alkaloids processes most of its morphine CPS into codeine and other APIs in Tasmania, whilst Glaxo Wellcome exports most of its production as CPS. Tasmanian Alkaloids also produces thebaine CPS which is predominantly used for oxycodone synthesis. The seeds contain no significant amount of alkaloids and are sold for culinary purposes.

Tasmania's Position in the World Opium Alkaloid Market Place

Australia produced 51% of the world's morphine CPS in 1998, the most recent year for which figures are available (2). Turkey produced 23%, France 21% and Spain 4%. The other major producer is India, which manufactures the traditional product opium. Opium contains approximately 10% morphine, and smaller

amounts of other alkaloids including thebaine. India's production of opium alkaloids is currently similar to that of Australia.

The UK and USA are the largest markets for CPS, importing 49 and 38 tonnes respectively in 1998. The USA is the largest importer of opium; 541 tonnes in 1998. The USA has a policy of sourcing 80% of its narcotic raw materials from the traditional producers, India and Turkey (the "80:20 rule"), and doesn't import APIs such as codeine phosphate.

Whilst thebaine is a minor constituent of opium poppies, it is the main alkaloid present in a new variety of *P. somniferum* developed by Tasmanian Alkaloids. Thebaine is not itself used in therapy, but is an important raw material in the manufacture of several opioids such as oxycodone and buprenorphine and nal-compounds such as naloxone and naltrexone. The major markets for thebaine are USA, where imports are not restricted under the 80:20 rule, and Europe. The majority of the Tasmanian Alkaloids crop is now sown to thebaine varieties.

Table 1 compares the efficiency of the Australian poppy industry with its major competitors (excluding India). Of the countries which grow poppies for CPS, Australia has 10.7% of the crop area, and produces 45.8% of the world's CPS. By contrast, Turkey has 46.5% of the area and produces 24.5% of the CPS. Australia's yield per hectare is 8 times that of Turkey, nearly twice that of Spain and 30% higher than France.

It is necessary for the Australian industry to have these yield advantages to compete in the world market. France has a large protected local market for codeine. The industries in Turkey and India are run by the governments as rural assistance programs, and these countries have much lower wages than Australia.

Table 1. Comparison of production figures averaged over 1994 to 1998 for countries growing poppy straw for use in production of CPS¹.

Country	Area		Straw harvested		Straw yield (kg/ha)	CPS produced ²		Yield in CPS (%) ³	Alkaloid Yield (kg/ha)
	ha	% of total	Tonnes	% of total		Tonnes	% of total		
Australia	8687	10.7	5904	19.4	686	81	45.8	1.28	9.3
France	5959	7.3	4806	15.8	805	42	23.6	1.08	7.0
Spain	1822	2.2	430	1.4	269	9	4.8	1.09	4.9
Turkey	37897	46.5	16231	53.4	426	43	24.5	0.33	1.1

¹All data based on UN figures (2).

²The concentration of alkaloid in CPS varies. All CPS figures are corrected to 100% alkaloid basis.

³An estimate of straw alkaloid content (alkaloid in CPS/straw processed x 100). Note that this is after processing so actual content is higher.

Establishment of the Industry in Tasmania

The establishment of the poppy industry in Australia, and the public sector research is reviewed by Laughlin et al. (3). Early work was done in the late 1800s in NSW, and in the 1940s by CSIRO. The poppy industry was introduced to Tasmania in the late 1960s by the Edinburgh based company, Macfarlan Smith, a subsidiary of Glaxo. Macfarlan Smith had been doing trial work in the UK aimed at establishing the industry in that country, but finally recognised that the unreliable English summer was not suitable for poppy production. Their researcher, Mr Steven King, examined weather records for several countries and came to Australia with a view to establishing the industry in Victoria. The Victorian government was not interested in the proposal, and Mr King turned his attention to Tasmania, a location which he had previously overlooked due to not having climate data. He found the Tasmanian Department of Agriculture¹ a willing partner in establishing trials, and over several years Tasmania was confirmed as a suitable location for poppy cultivation. Glaxo established a crop reception facility at Latrobe, Tasmania, and converted a milk powder factory at Port Fairy on the south coast of Victoria, into an extraction plant for the production of CPS. Glaxo is now known as Glaxo Wellcome.

¹ The Tasmanian Department of Agriculture has had several name changes. Hereafter, the current name Department of Primary Industries Water and Environment (DPIWE) is used.

Tasmanian Alkaloids was established in 1975 as a joint operation between Abbott Laboratories and Ciech Polfa. Abbott Laboratories had a codeine manufacturing plant in Kurnell, NSW and were seeking to establish their own source of raw materials. Ciech Polfa was a Polish company with experience in the cultivation of poppies and extraction of poppy straw. The company was established at Westbury, where initially CPS and poppy seed were produced. The company was purchased by Johnson & Johnson in 1982, who moved the codeine plant to the Westbury site. Johnson & Johnson are manufacturers of the Tylenol range of pain medication, and purchase of Tasmanian Alkaloids was made to ensure a reliable source of raw materials.

Tasmania has proved to be an excellent location for the poppy industry. The crop fits well into a rotation with vegetable crops in the basaltic soils on the north west coast, and with cereal crops in the midlands and south. The cool temperate climate allows the plants to grow well during spring, and the relatively dry summers allow harvest of crops with little need for artificial drying. The cool climate allows production with only sporadic problems from *Helicoverpa* and other insect pests which would be a significant problem in warmer areas. These natural advantages combined with technological developments and skilled farmers have enabled Tasmania to consistently produce the highest alkaloid yields in the world (Table 1).

The isolation of Tasmania is also an advantage for narcotic security. Tasmania has an excellent record in security and is the benchmark for other producing nations.

Growth of Industry

When the industry was in its infancy, poppies were not a popular crop amongst many growers. The crop failure rate was high and the factors affecting alkaloid content were not well understood, so growers were often disappointed by achieving low returns on what appeared to be good crops. Weed control was often poor, resulting in a build up of weeds.

With the development of high yielding cultivars, an understanding of nutritional and irrigation requirements, and development of reliable weed control methods, the popularity of the crop increased with growers, and gradually the area increased from less than 4000 ha in 1987 to almost 20,000 ha currently (Figure 1). The area sown to poppies is currently equal to that sown to potatoes, peas, green beans, onions, brassicas and pyrethrum combined. The success of the industry is due to the capacity of Tasmania to compete on the market with overseas producers, whilst paying growers, contractors and employees a fair return for their efforts. Efficiencies brought about by the application of science and technology have been a critical contributor to this success.

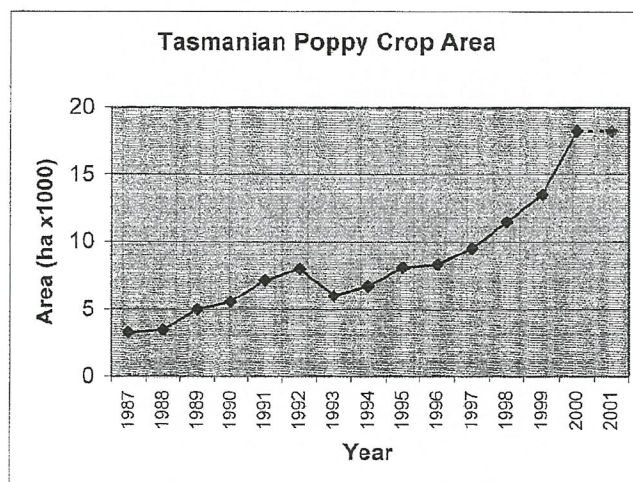


Figure 1. Area of poppies grown in Tasmania (2). The figure for 2001 is an estimate.

Role Of Science And Technology In The Tasmanian Poppy Industry

The basic requirements of the industry are crops with a high alkaloid percentage in the straw, and a high alkaloid yield per hectare. High alkaloid crops allow efficient extraction of alkaloids. Processing costs are either fixed (depreciation, wages, maintenance), or depend on the volume of the straw processed (e.g. crop transport, crop storage, extraction). Thus, the cost of producing a kilogram of alkaloid is substantially less with higher alkaloid content crops.

Alkaloid yield has little relevance to the extraction process, but is important for two reasons. The industry is confined to Tasmania which has a limited amount of land suitable for poppy cultivation. Therefore, increases in production increasingly depend on the achievement of additional yield, rather than increasing area of cultivation. Additionally, the return per hectare must be sufficient for poppies to compete against other agricultural enterprises. Commercial alkaloid yields are now approximately 3 times those achieved when Tasmanian Alkaloids first started contracting poppy crops.

Alkaloid yield is a product of straw yield and the straw alkaloid content (Figure 2). The major factors affecting alkaloid % are the genotype and the nitrogen nutrition of the crop. Straw yield is influenced by genotype, nitrogen and phosphorus nutrition, soil water status (rainfall) and weeds, pest and disease. Innovations which influence alkaloid content in the straw are more valuable to the industry than those which influence just straw yield. This is because increases in alkaloid content create improvements in alkaloid yield as well, fulfilling both requirements.

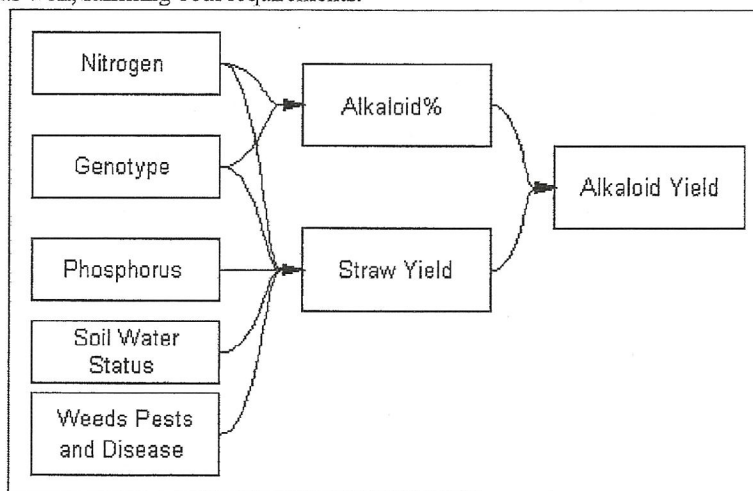


Figure 2. The relationship between straw yield, alkaloid % and alkaloid yield, and the factors which have the main influence on these outcomes.

Examples of Science and Technology in the Poppy Industry

Understanding the climate required for poppy cultivation, and utilisation of weather data in the selection of Tasmania by Stephen King was probably the first and most basic use of science and technology in the development of the industry. There have since been many developments in the industry which have contributed to the very strong position which it now holds in the local economy. These are summarised in Table 2. Due to the nature of the industry, few of these developments have been described in the scientific literature. Three developments are described below to illustrate a range of projects familiar to the author.

Example 1. Cost Reduction in Weed Control through better Understanding of the Mechanisms Involved.

Diquat (Reglone ®) was the first herbicide used in poppies (4). Diquat is usually considered a non-selective herbicide with best effects on broadleaf weeds. However it causes little damage to poppies, due to the surface characteristics of poppy leaves. It was found that mixing diquat with various herbicides

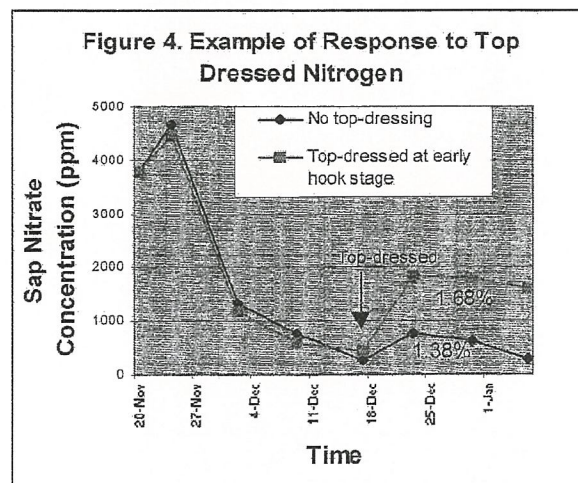
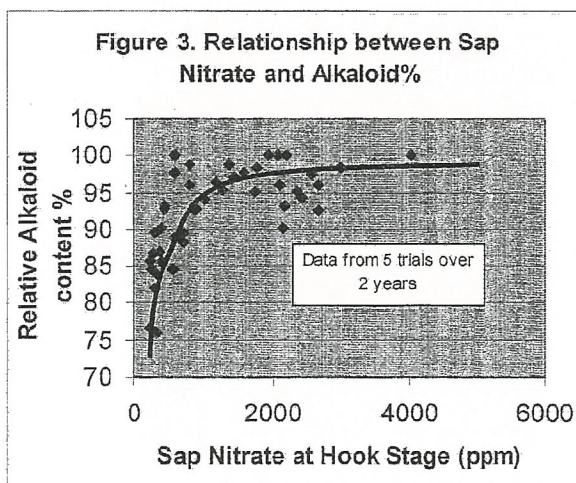
increased the range of broadleaf weeds controlled (4). A number of different herbicides have been used to mix with diquat. The most recent was Hoegrass® (diclofop-methyl). This was surprising, as diclofop-methyl is normally active only against annual grasses. In fact, in small plot trials conducted by Tasmanian Alkaloids, it was found that mixing an emulsifiable concentrate (EC) insecticide with diquat had the same effect. Therefore the hypothesis was formed that the EC formulation of the added product, rather than the active ingredients, modified the activity of diquat. This idea led to a research project conducted by Tasmanian Alkaloids and a collaboration with the School of Agricultural Science, University of Tasmania. The research at Tasmanian Alkaloids involved testing a wide range of surface-active agents to evaluate their effect on the efficacy of diquat.

The work at the University investigated the effect of adjuvants on the contact angle between a diquat-containing water droplet and the leaves of poppies and weeds (5). It was shown that the adjuvants modified this contact angle, increasing the wetting effect of the droplet. Poppies were found to be harder to wet (higher contact angles) than the major weeds. A Hoegrass EC Blank formulation (diclofop-methyl absent) had the same effect as Hoegrass, proving the hypothesis that the herbicidal additives to diquat were effective by virtue of their excipients. This allowed the identification and marketing of an adjuvant as a replacement for EC herbicides, with a saving to growers of \$37 per hectare.

In this example, the initial idea came from Tasmanian Alkaloids. Serve-Ag (a Tasmanian agribusiness company) supplied samples of a wide range of wetting agents, and the University of Tasmania provided the data that proved the hypothesis. The close relationship between Serve-Ag and Tasmanian Alkaloids also assisted in the new product being brought to market. This was one of many small improvements to the weed control strategies originally devised by the DPIWE (4).

Example 2. Development of Nitrogen Nutrition Guidelines

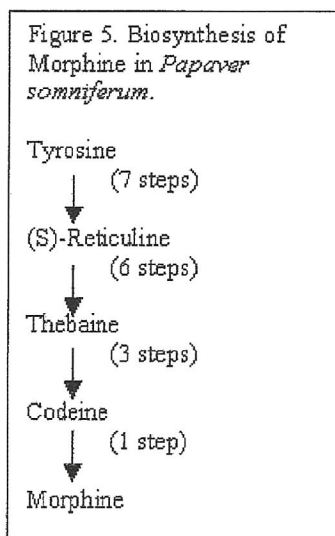
Work conducted by DPIWE (summarised by Laughlin et al., (3)), showed that in some circumstances poppies would respond to top-dressed nitrogen. However, it was recognised in the industry that not all crops would respond, and the use of top-dressed nitrogen was very small due to this uncertainty. Tasmanian Alkaloids started work on nitrogen nutrition of poppies in 1988 following discussions with DPIWE. At the same time Serve-Ag introduced a rapid sap testing service for leaf nitrate. The project determined critical nitrogen concentrations in leaf tissues for alkaloid percentage in poppy straw (Figure 3), and demonstrated that significant increases in crop alkaloid content could be achieved by optimising nitrogen nutrition at the hook stage (Figure 4). In this example, the final alkaloid content in the straw was increased from 1.38% to 1.68% following a single nitrogen application at early hook stage. Field testing showed that in some years virtually all crops required nitrogen top-dressing, whilst in other seasons, only some crops were deficient. Company field officers now promote sap testing and nitrogen applications. Adoption rates of the strategy have increased to quite high levels, and the occurrence of unexpectedly low alkaloid content crops is very much lower than it was 10 years ago, largely due to the recognition of nitrogen deficiency as a major cause of low alkaloid content.



In this example, the DPIWE provided the initial research results that demonstrated the potential benefits from top-dressed nitrogen. DPIWE also had expertise in sap nitrate testing, which was utilised by Serve-Ag in providing the commercial sap testing service. Tasmanian Alkaloids recognised the need to identify the critical plant nitrate concentrations, conducted the research, and promoted the strategies to growers.

Example 3. Development of Thebaine Poppy

Until 1996, Tasmania was a small producer of thebaine, which was extracted from poppies grown primarily for morphine. For several years, Tasmanian Alkaloids cultivated varieties with enhanced thebaine content, up to about 15% of the morphine content depending on the dryness of the growing season. However, thebaine was difficult to extract from these varieties because it separated into "tarry" fractions during processing. Researchers at Tasmanian Alkaloids recognised that there was a possibility of breeding a poppy variety in which the biosynthetic pathway stopped at thebaine instead of going on to produce morphine (Figure 5). Nyman and Hall (6) had previously selected a spontaneous mutant containing high thebaine content, but after many years attempting to breed a pure line of this variety, concluded that the mutant had a chromosomal instability and a large proportion of each new generation regressed to a morphine type (7).



A research project was established at Tasmanian Alkaloids in 1994 in order to develop a high thebaine poppy variety to meet the anticipated demand. Several methods to block the synthetic pathway at thebaine were considered. The merits of mutagenesis versus genetic engineering were debated and the decision was made to utilise mutagenesis, which has proved wise considering the uncertainty regarding genetic engineering. Prior to starting a mutagenesis program, the techniques of inducing the appropriate rate of mutation, and most importantly, the screening techniques, were developed. Mutagenesis has been used in *P. somniferum* previously but the alkaloid content of large numbers of individual plants had never been tested. Tasmanian Alkaloids developed an analytical method capable of screening 1000 plants per week. The method utilised a tiny droplet of latex collected from an excised leaf. The droplet was extracted in a buffer, and analysed by HPLC utilising a very rapid method. This allowed non-destructive qualitative analysis of young seedlings for the major alkaloids found in latex. Plants with unusual alkaloid profiles were re-tested, and those passing the second test were grown to maturity.

A large number of alkaloid mutants were selected from the M₂ population using this method. The most important selection commercially was the 233rd selection, which came to be known as Norman. This plant was free of morphine and codeine, and its latex contained just two major alkaloids, thebaine and oripavine. Oripavine has never previously been available in quantity. It can be methylated to produce thebaine, using a similar process to that used to produce codeine from morphine. Subsequent generations have shown that the morphine-free characteristic is due to a single recessive gene. This new variety was first grown commercially in 1996/7 (500 ha). Since that time the crop area sown to this variety has

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-----Original Message-----

From: Sackler, Jonathan

Sent: Thursday, February 07, 2002 7:02 AM

To: Sackler, Dr Mortimer; Sackler, Mortimer JR; Mahony, Edward; Albright, Edward; Sackler, Beverly; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco- Mallinckrodt

If I understand this idea, we would contribute the Rhodes facility + ~\$700mill in cash to acquire Mallinckrodt, then we would take the company public. I don't think Mallinckrodt is the property to stretch for. Another idea would be to contribute the Rhodes facility and essentially no cash in exchange for a minority interest in what we hope will become a publicly traded Mallinckrodt. I don't think that works for us either. Let me point out some facts.

1. While the people at Rhodes are making a strong attempt to develop a book of outside business, at the moment there is none.
2. To the best of my knowledge, Mallinckrodt is not facility-constrained.
3. The only concrete value Rhodes brings to Mallinckrodt is Purdue's oxycodone requirement.
4. We are relying on Mallinckrodt to supply a lot of oxycodone this year, but down the road the bulk of our demand will switch to Noramco's inexpensive thebaine. From what I gather, because of their ownership of the super-poppy, Noramco enjoys a huge cost advantage in thebaine.
5. Ed has played these 2 suppliers off against each other very skillfully, extracting price concessions from Mallinckrodt while lining up Noramco. I don't think we want to expose our position to Mallinckrodt, but at the moment they are destined to be a much smaller part of our future supply.
6. Selling the Rhodes facility to Mallinckrodt for some minority position in their stock will return us to the status of a passive customer buying from a duopoly. If we try to lock Mallinckrodt in to a low price, then we're severely limiting the value we bring to the deal. In fact, the cost we expect to achieve with Noramco's thebaine is probably close to Mallinckrodt's cost.
7. With all the regulatory challenges in Totowa, Ed has been asked to devote himself 100% to that operation until we're out of danger. I don't think we want to ask him or his team to lead a Mallinckrodt due diligence.

8. We're trying to build solid, long-term relationships with Par and Mylan. If they learned we were contemplating selling out to Mallinckrodt, those discussions might be compromised.

9. We have a couple of key people (Kupper and Shamblen) working very hard to create a business at Rhodes. I think we want to keep them focused on our strategy to build a business on several key customers, first and foremost Purdue.

10. I don't think anyone imagines we want to invest substantial cash to hold a controlling position in Mallinckrodt.

Doing a deal like this will involve a huge amount of work, expense and exposure. I don't think this is the one to pursue.

Jon Sackler

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Assistant: Alicia Laing (203) 588-7202 alicia.laing@pharma.com

-----Original Message-----

From: Sackler, Dr Mortimer

Sent: Thursday, February 07, 2002 5:09 AM

To: Sackler, Mortimer JR; Mahony, Edward; Albright, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco- Mallickrodt

I would appreciate , if the B Directors agree, that Morti Jr's proposal be explored with an agreed Merchant Bank Group if Morgan Chase is ruled out for any reason. This would put the Rhodes operation on an independant fiscal footing and help reduce the risk for the future. I believe we now have close to 100 mio invested.

The environmenta question that has been raised in re the plants involved will have to be isolated in some way.

-----Original Message-----

From: Sackler, Mortimer JR

Sent: Wednesday, February 06, 2002 11:10 PM

To: Mahony, Edward; Albright, Edward; Sackler, Dr Mortimer; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

What if we had Rhodes purchase Malinckrodt Pharmaceuticals, and then take the combined entity public to pay off/down the debt? I am sure this could be structured with the right investment banker, if it made sense to do. Tyco should be willing to sell the business at a reduced multiple to what could be achieved in a public offering, because it would enable them to generate liquidity faster and would be a cleaner split/transaction for them. This would mean that with the addition of the Rhodes business and the discount on the purchase we could end up owning a substantial portion of the equity of this large business while taking a very small equity risk ourselves. I would imagine this whole deal being financed completely separate from Purdue.

Do others believe that this is worth studying out and exploring further?

Regards,

Mortimer

-----Original Message-----

From: Mahony, Edward

Sent: Wednesday, February 06, 2002 3:30 PM

To: Albright, Edward; Sackler, Dr Mortimer; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

I agree with Ed Albright. We have limited capacity to raise new money, while staying within our current private structure. I would not use our limited capacity to buy Mallinckrodt's narcotic business.

Best regards,

Ed

-----Original Message-----

From: Albright, Edward

Sent: Wednesday, February 06, 2002 1:59 PM

To: Sackler, Dr Mortimer; Mahony, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

Mallinckrodt met with us yesterday at Totowa. Tyco plans to spin out 4 businesses from Tyco, including Heath Care (including Mallinckrodt). Mallinckrodt's sales are in the \$800 million area. The financial methodology for these "spin offs" were a little confusing, but we were told they would issue 4 separate IPO's (supposedly at 20% value). Bottom line is we will not have any raw material shortages from Mallinckrodt in 2002 (we plan to purchase 17 tons this year). There may be issues beyond 2002, but both Rhodes and Noramco can easily replace all of Mallinckrodt's volume in 2003 and beyond. I'm sure Tyco would entertain a buyout for Mallinckrodt, but am not sure they would respond favorably to only buying a piece of the business. The \$800 million sales (even at only a 1X multiple) seems out of our range and there are certainly environmental issues in the St. Louis plant.

-----Original Message-----

From: Sackler, Dr Mortimer

Sent: Wednesday, February 06, 2002 12:05 PM

To: Mahony, Edward; Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Albright, Edward; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: RE: Tyco

Thanks Ed Mahony for the news analysis.

Ed Albright: Are we exposed to a possible raw material production shortage if Mallinckrodt's parents or siblings put it into a fiscal mess. Will Rhodes be able to make up for shortages? When does Rhodes enter the supply chain for oxycodone

Michael et al: Could we negotiate to buy Mallinckrodt with a payout overtime or would such an idea not be helpful to Tyco?

-----Original Message-----

From: Mahony, Edward

Sent: Wednesday, February 06, 2002 3:52 PM

To: Sackler, Beverly; Sackler, Jonathan; Sackler, Dr Kathe; Sackler, Dr Mortimer; Sackler, Mortimer JR; Sackler, Dr Raymond R; Sackler, Dr Richard; Sackler, Theresa; White, Jonathan; Albright, Edward; Friedman, Michael; Goldenheim, Paul; Udell, Howard; Baker, Stuart D.; Shaw, Hank

Subject: Tyco

Colleagues,

FYI . . . Tyco (parent of Mallinckrodt, a major supplier to Purdue) has been under a microscope in the financial markets lately. Dan Colucci summarizes below some of the recent news. A few years ago we briefly discussed buying Mallinckrodt. In my view, a purchase of Mallinckrodt financed by debt would not be viable at this time.

Ed

-----Original Message-----

From: Colucci, Dan

Sent: Tuesday, February 05, 2002 11:36 PM

To: Mahony, Edward; Suffredini, Michael

Subject: Tyco International--some information

Importance: High

Here is some information on the their recent troubles. It is very complex and I gave it a quick read. As you know, they own Mallinckrodt.

Chronology first:

--Shortly after 1/01/02, their stock was at \$59.00 with a market cap of \$118.0 billion. At that time they began to be hit with rumors of poor accounting. This was not good in light of Enron. It was not the first time rumors had swirled.

--On January 22, with the stock drifting downward, they announced they would split into four companies to unlock shareholder value. The shares jumped back to \$50.00.

--In late January, the stock fell further as bonus amounts to the Chairman, high consultant fees to auditors, and a \$20.0 million consulting fee to a director and a charity are announced.

--On 2/1 it was announced they had made \$8.0 billion in acquisitions without disclosing them during 2001. They said they were immaterial in light of the size of the organization.

--2/4 S&P cuts their senior unsecured debt from A to BBB, two notches above junk, and their CP rating from A1 to A3, one notch above junk. Tyco Capital (the old CIT Finance, an asset-based lender recently acquired by Tyco) is cut from A+ to A-. Tyco International, fearing the CP markets will be cut off from them, borrows on their \$5.9 billion line of credit to pay \$4.0 billion in commercial paper. On 2/5 Tyco Capitol also draws on its lines of credit to retire debt.

--2/5 Market Cap \$46 billion.

Here is a summary of recent results. On paper, what is happening does not seem warranted. One might argue, however, that the financials are meaningless due to the accounting rumors. In addition, given the state of the market, even if the numbers are valid it doesn't seem to matter. The news has made it impossible for them to borrow in the CP market affecting liquidity and borrowing rates. Given the debt load, they were going in the wrong direction.

--For the year ended 9/30/01, they earned almost \$4.0 billion on sales of \$36.4 billion. This compared to earnings of \$4.5 billion on sales of \$30.7 billion as of 9/00.

--They had total assets of \$111.3 billion at 9/30, and total debt of \$79.0 billion. All of the fiscal 2001 acquisitions increased debt by \$56.0 billion from 9/00 to 9/01. Cash from operations at 9/01 was \$6.7 billion, from investing <\$11.6 billion>, and from financing \$6.3 billion, bringing the total cash balance at 9/01 to \$2.6 billion.

--For the quarter ended 12/31, they earned \$1.4 billion on sales of \$10.1 billion. Cash balances stood at \$3.2 billion, while total debt grew slightly. They are projecting "\$4.0 billion in free cash flow" for the year, although during the first quarter it was <\$215.0 million> due to spending at one company. They also projected earnings guidance of \$3.70/share for fiscal 2002.

--The division Mallinckrodt is included in has a number of companies, had 9/01 sales of \$8.8 billion, and operating income of \$1.8 billion. We know Mallinckrodt had sales itself in 1999 of \$2.6 billion.

Message

From: Sackler, Dr Richard [/O=PURDUE/OU=EXTERNAL
(FYDIBOHF25SPDLT)/CN=RECIPIENTS/CN=3AFB14348C50493E95A6A5977146F48E]
Sent: 2/7/2002 8:02:29 AM
To: Sackler, Jonathan [/O=PURDUE/OU=EXTERNAL
(FYDIBOHF25SPDLT)/CN=RECIPIENTS/CN=EDCD012C2FCA40ECA986A3580BECA1AE]
Subject: RE: Tyco- Mallickrodt

It was great

But the one on point was even better.

Richard S. Sackler, M.D.

Laptop 2000 machine #7777-01

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Located in Connecticut

-----Original Message-----

From: Sackler, Jonathan
Sent: Thursday, February 07, 2002 7:40 AM
To: Sackler, Dr Richard
Subject: RE: Tyco- Mallickrodt

but did you like the other email? best i've done in years, if you ask me.

Jon Sackler

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Assistant: Alicia Laing (203) 588-7202 alicia.laing@pharma.com

-----Original Message-----

From: Sackler, Dr Richard
Sent: Thursday, February 07, 2002 7:35 AM
To: Sackler, Jonathan
Subject: RE: Tyco- Mallickrodt

I think that you have thoroughly destroyed this idea. Now I see why you thought it was stupid.

Richard S. Sackler, M.D.

Laptop 2000 machine #7777-01

One Stamford Forum

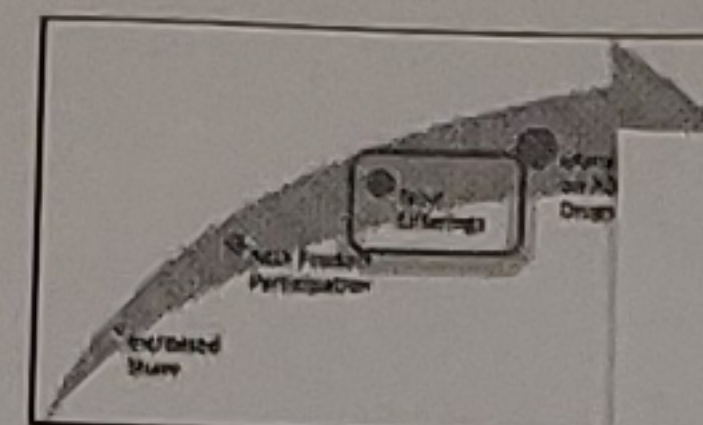
Stamford, CT 06901

Telephone 203 588 7777

PA 203 588 7779

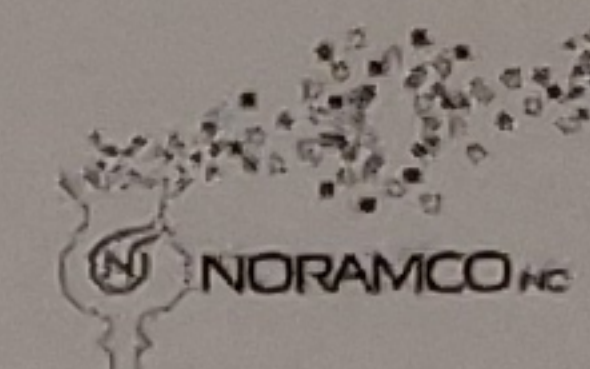
Internet rs@pharma.com

New Offering (Pipeline) from Noramco



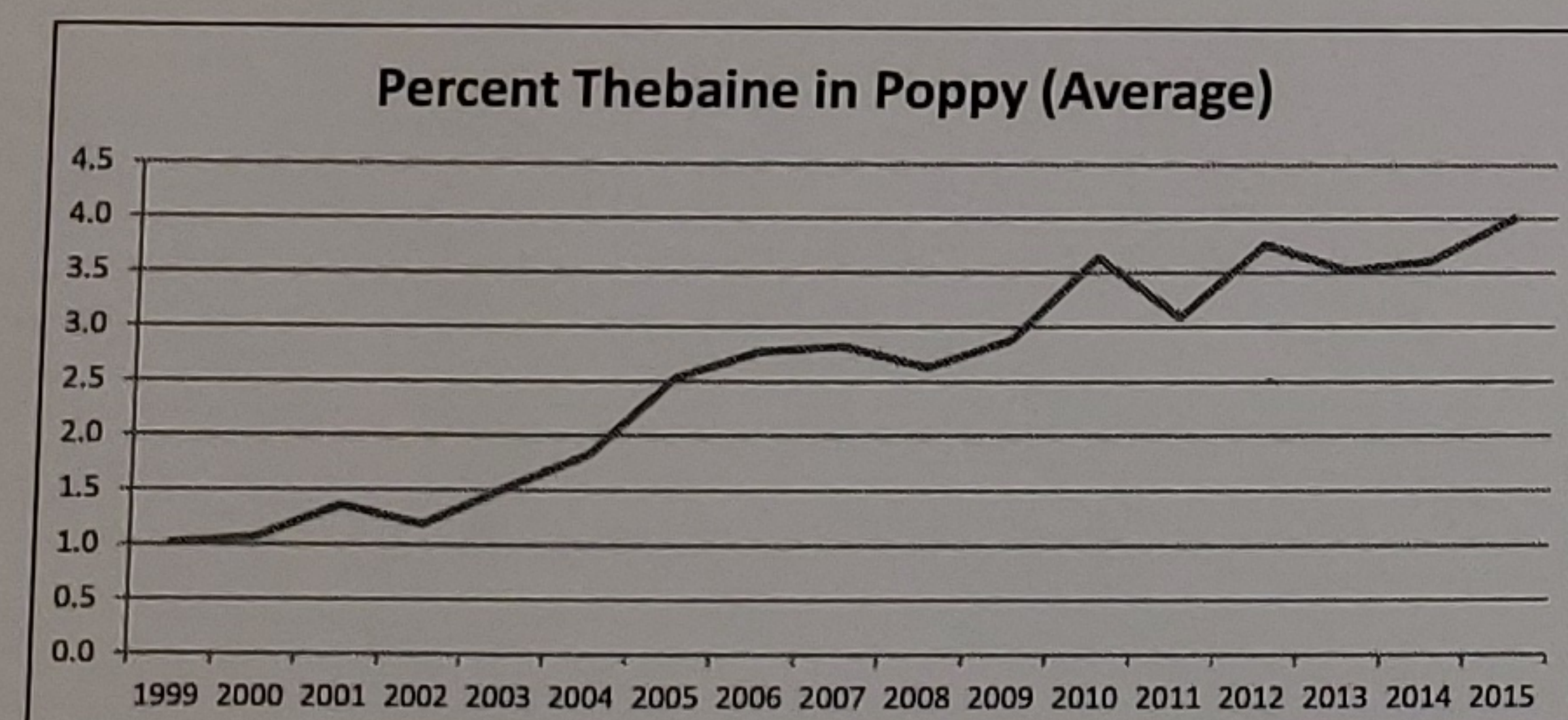
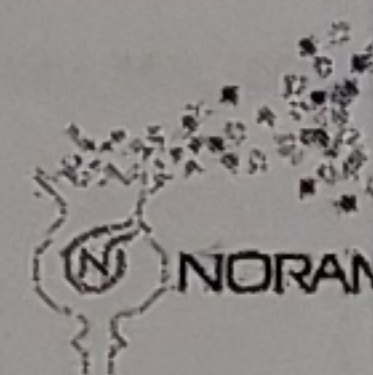
Noramco API	Cannabinoid Family	Amphetamines	Fentanyl
Company	Confidential	Confidential	Confidential
Product	Epidiolex® and Sativex® and their generics	Generics of Adderall®, Dexedrine®	Generics of Duragesic®, Actiq®
Indication	CNS, Seizure, Pain	ADHD	Pain
Status	Clinical material using Noramco IP. Purchase Order in hand	Q1 2016 Filing Launch 2017/2018	Filing submitted Feb 2015, assessing customer interest with samples
Market Comment	Confidential Estimate 10 to 50 tons	Current US Market ~26 tons, growing at 11%	US Market ~1,200kg

Tasmanian Alkaloids R&D - Three Areas of Work



- Plant Breeding and Improvement
 - On-going core activity that has delivered results
- Agronomy
 - Translating Agricultural R&D to the field
 - Leveraging Field Staff
- Biotechnology
 - Transformational innovation area

The Value of Agricultural Research

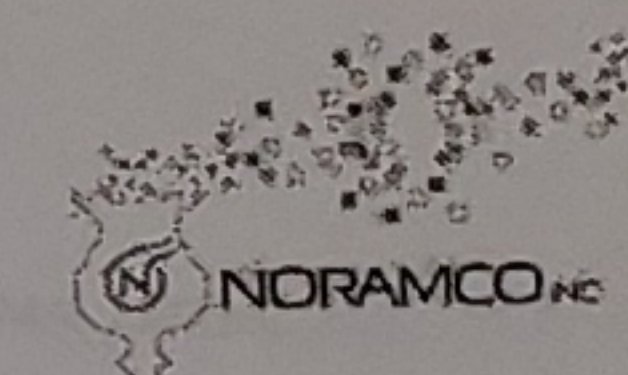


- Narcotic raw material is the single biggest contributor to API costs
- Tasmanian Alkaloids has increased the alkaloid content by 300% over the last 15 years
- INCB data validate that these increases are unparalleled in the industry

Confidential

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Biotechnology – In Tasmania



Description

Develop poppy polyploids for commercial crop production using targeted mutagenesis and gene regulation

Objectives

Increase efficiency of alkaloid production

Desired Outcomes

Increase Thebaine and Codeine alkaloid content from current level by 20% in the near term and 50%+ long-term

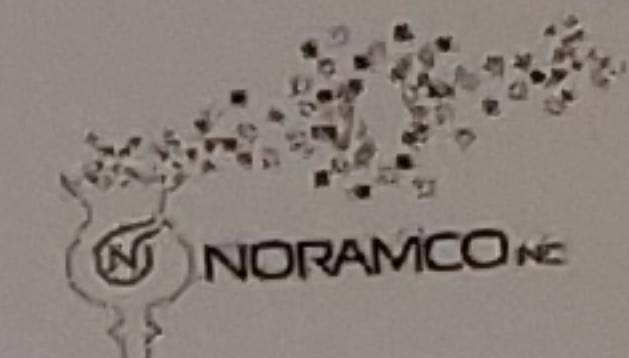
Development of seedless or sterile commercial varieties

Provide new parent material for conventional breeding

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Noramco



Noramco Global Product Portfolio



Noramco Family of Active Ingredients	Representative Brand Drug Product	Indication	Net Trade Sales* 2014 in USD MM
Oxycodone	Oxycontin®, Percocet®, Roxicodone®	Pain	\$94
Hydrocodone	Vicodin®, Lortab®	Pain	52
Buprenorphine	Bu-trans®, Norspan®	Pain or addiction	20
Morphine	Suboxone®, Subutex®	Pain	20
Codeine	Laudanon®	Pain	18
Hydromorphone	Dilaudid®, Exalgo®	Pain	9
Naloxone	Narcan®, Evzio®	Overdose or abuse	2
Other / Intermediates		ADHD and Pain	23
Narcotic Raw Materials			20
Global 2014 Net Trade Sales value			\$258

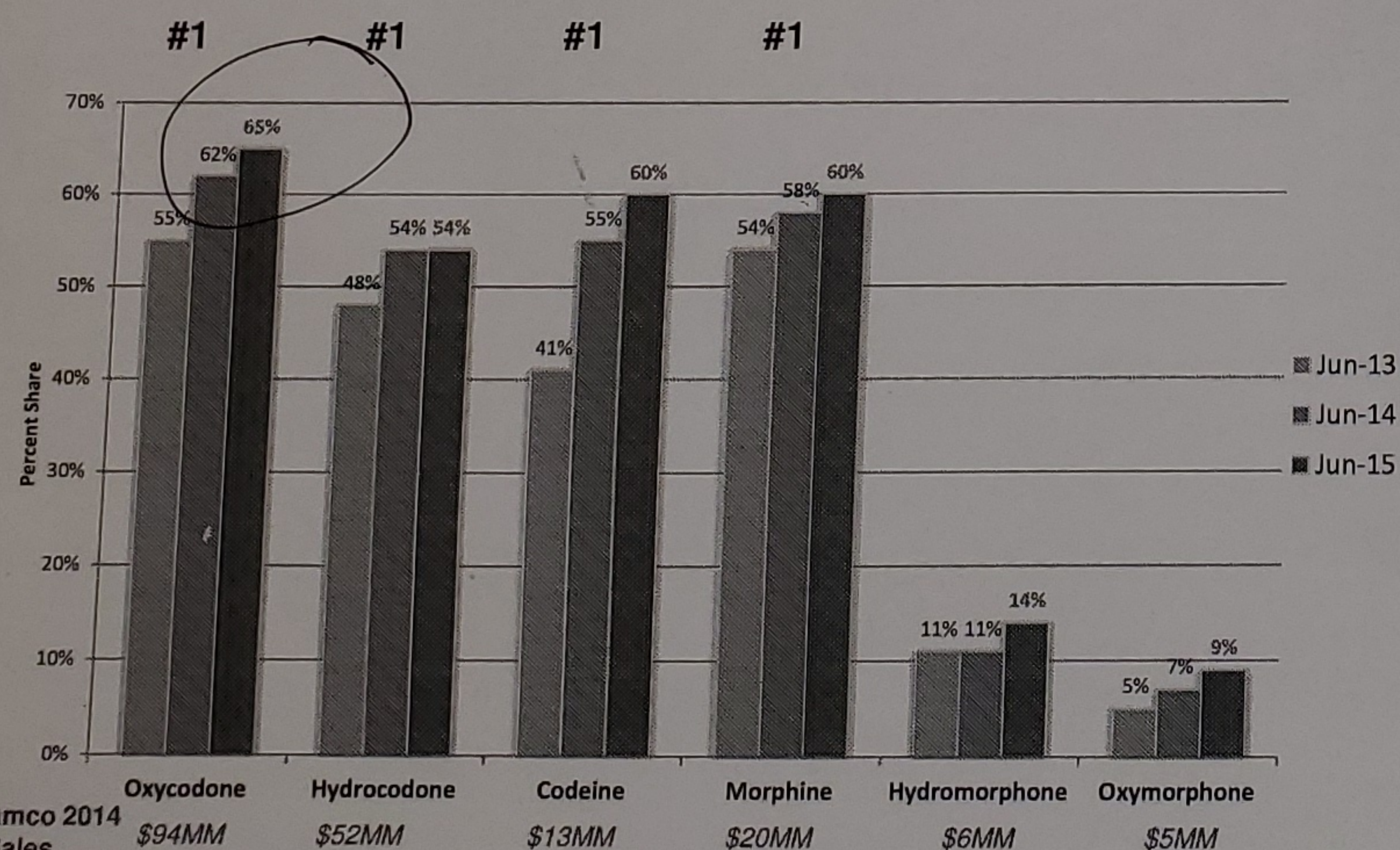
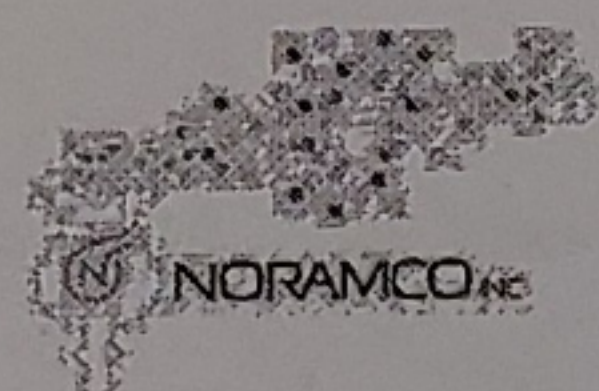
Narcotics US & Global Volume Drivers

- API volume growth linked to expanded use of analgesics driven by aging population and OUS expanded access
- API volume growth linked to generics of Branded drugs, new delivery systems & abuse prevention claims
- No revolutionary new narcotic NRM /API but new uses found
 - Naloxone as a combination for abuse deterrent
 - Methylnaltrexone for constipation
 - Naltrexone for weight loss, drug addiction
- Buprenorphine showing global growth for drug abuse and pain

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Noramco Has Steadily Gained US Market Share



Source for Share: IMS sales data,
Source for Noramco US sales: unaudited company financials

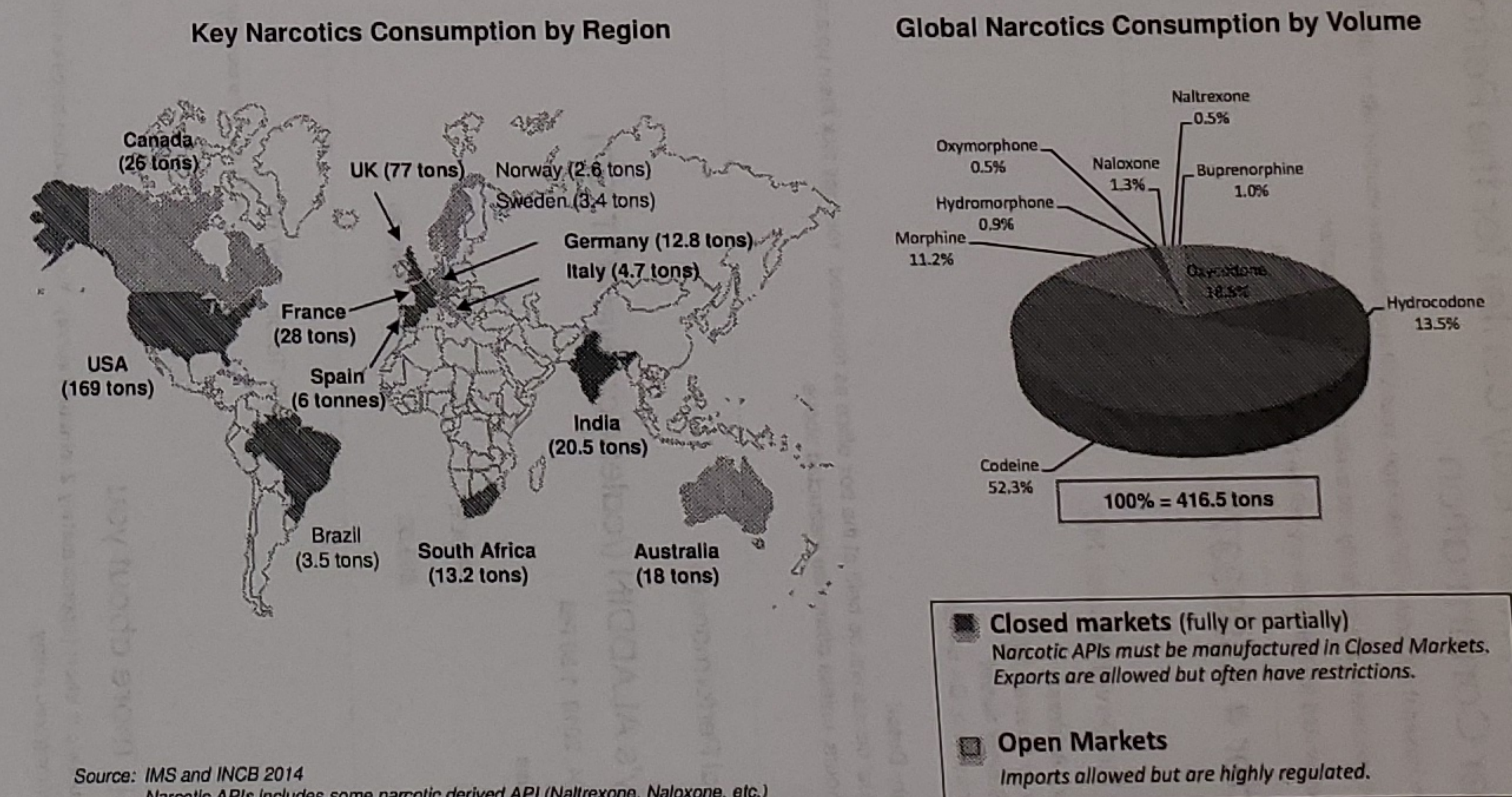
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Ten Markets Account for 90% of Global Consumption of Narcotic API's



Source: IMS and INCB 2014
Narcotic APIs includes some narcotic derived API (Naltrexone, Naloxone, etc.)

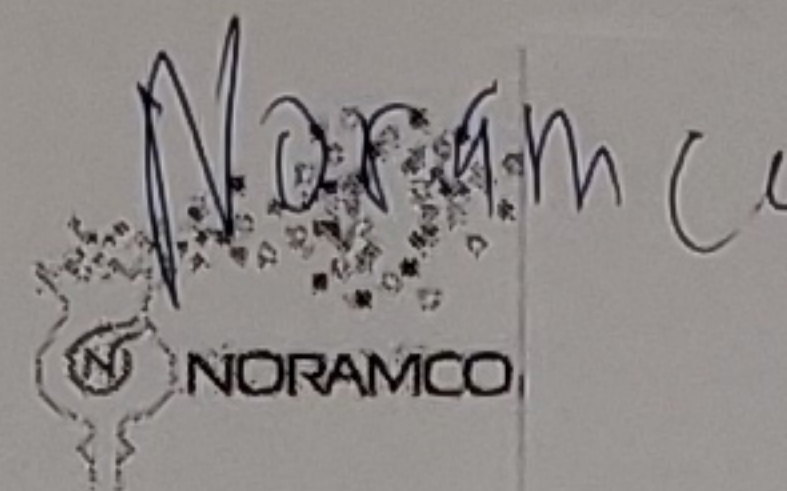
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Narcotics Global Trends And Future



Global Market Past

- Codeine and Morphine primarily used for analgesics OUS
- Enforcement reduced market size by ~2% per year from 2011 to end of 2014, appears to be stabilizing
- Stronger analgesics (Oxycodone, Hydromorphone, Oxymorphone) reformulated for Extended Release presentations

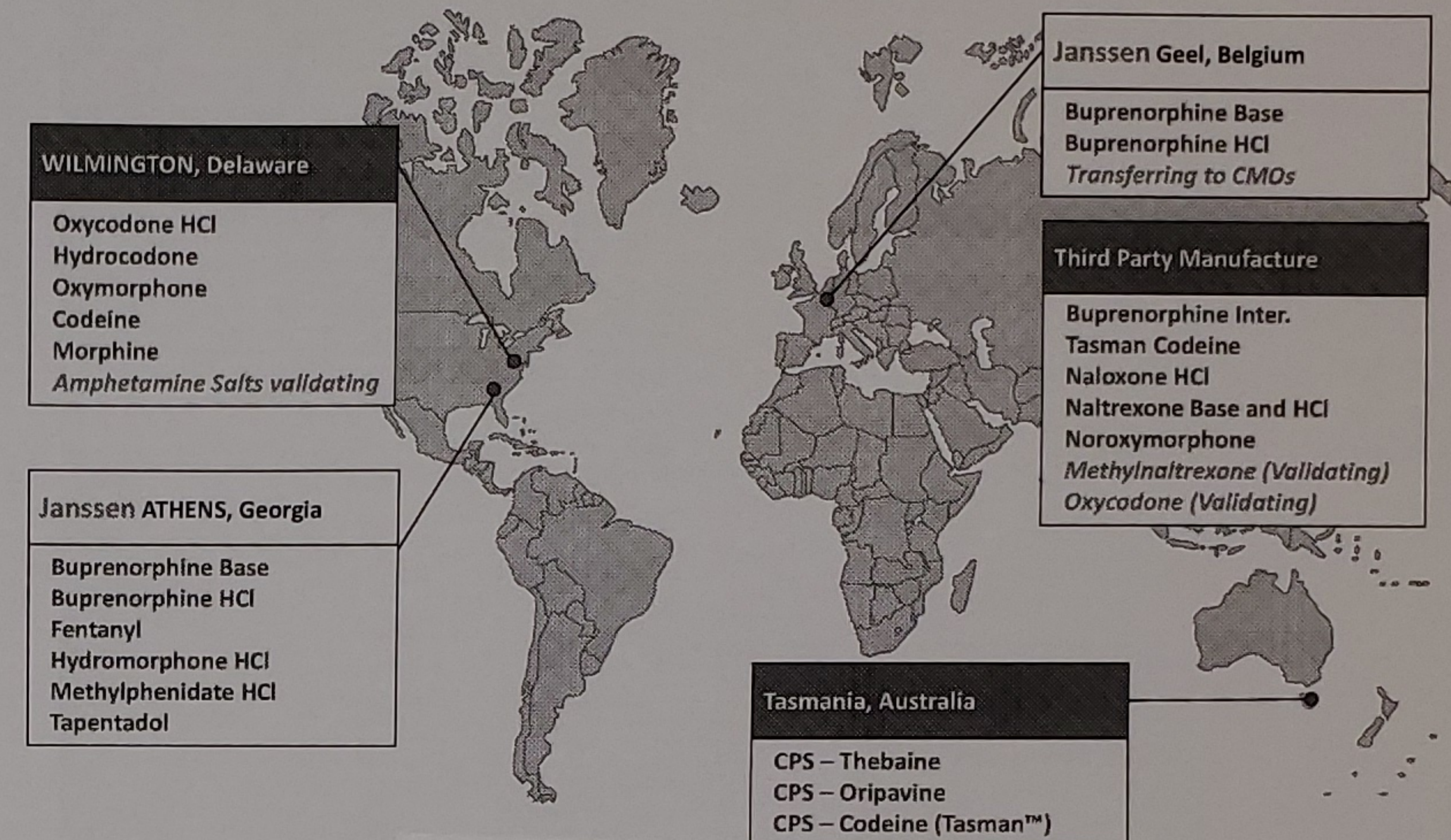
Global Market Future Trends

- Aging population and increasing wealth increase analgesic demand
- Stronger analgesics in Abuse Deterrent presentations will gain more acceptance in new markets
- US Multinationals will continue to expand pain franchises OUS with Generics and Branded Generics

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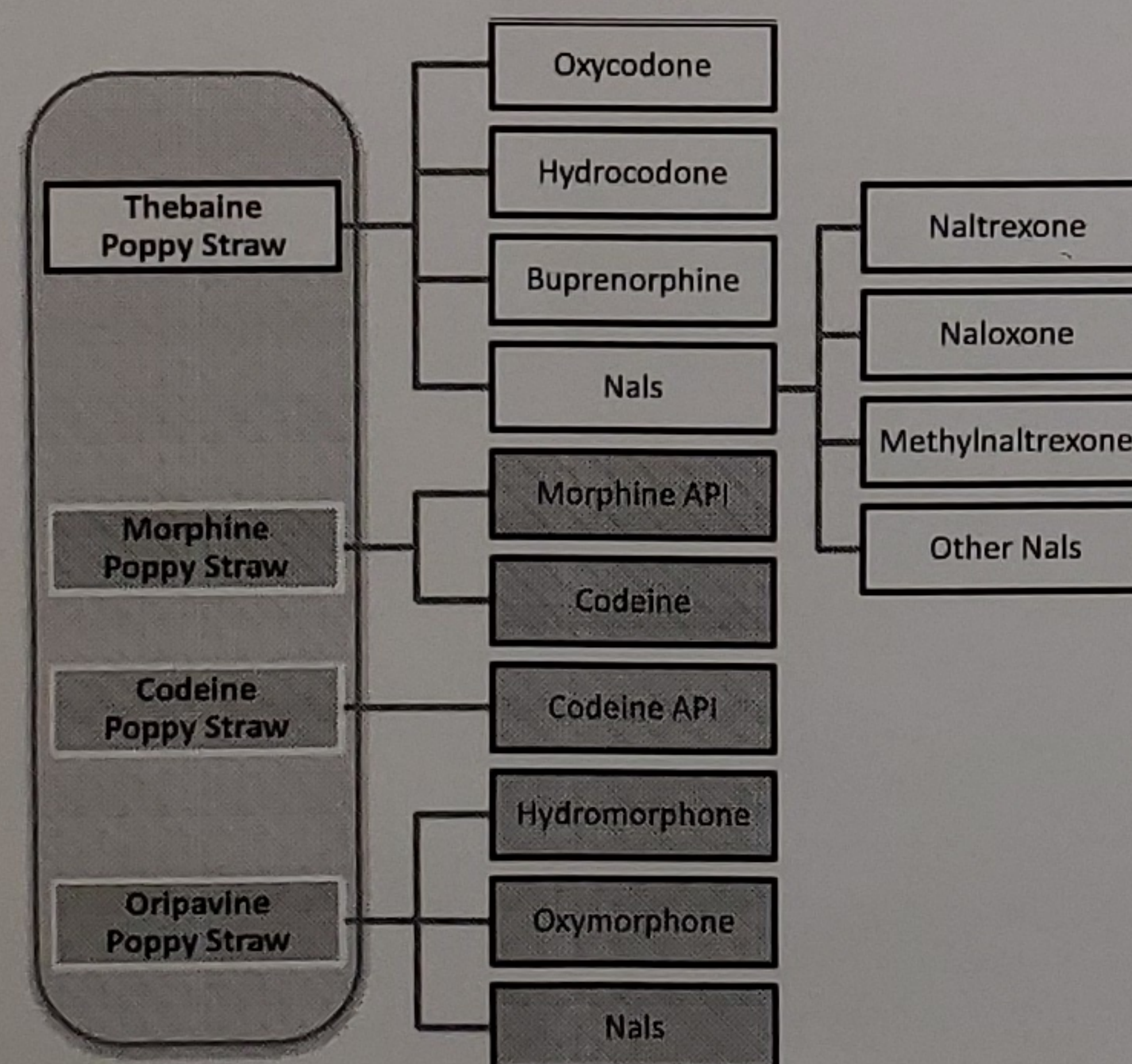
24

Noramco Manufacturing Network



Note: This is a summary, not intended to show all office relationships

Narcotic Raw Material Is A Critical Foundation In A Complex Supply Chain

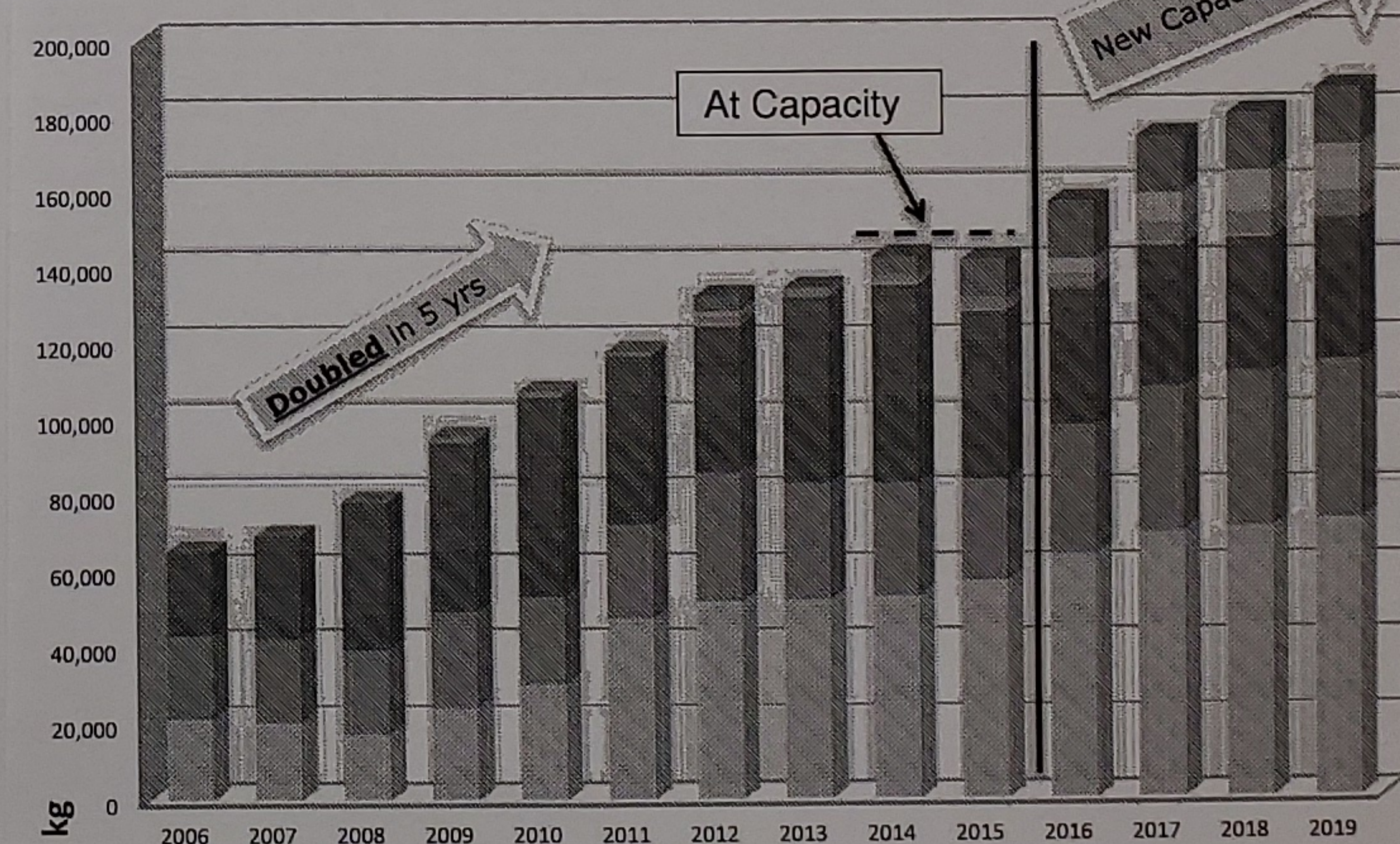


INCB report issued March 2015 notes that Tasmania produces 77% of the World thebaine

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Wilmington API Volume Growth 2006-2019



■ Oxycodone HCl
 ■ Morphine Sulfate
 ■ Oxymorphone, crude (COMd)
 ■ Hydrocodone Bitartrate
 ■ Technical Thebaine
 ■ Amphetamines
 ■ Codeine Phosphate
 ■ Oxymorphone HCl
 ■ Tapentadol Intermediate

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